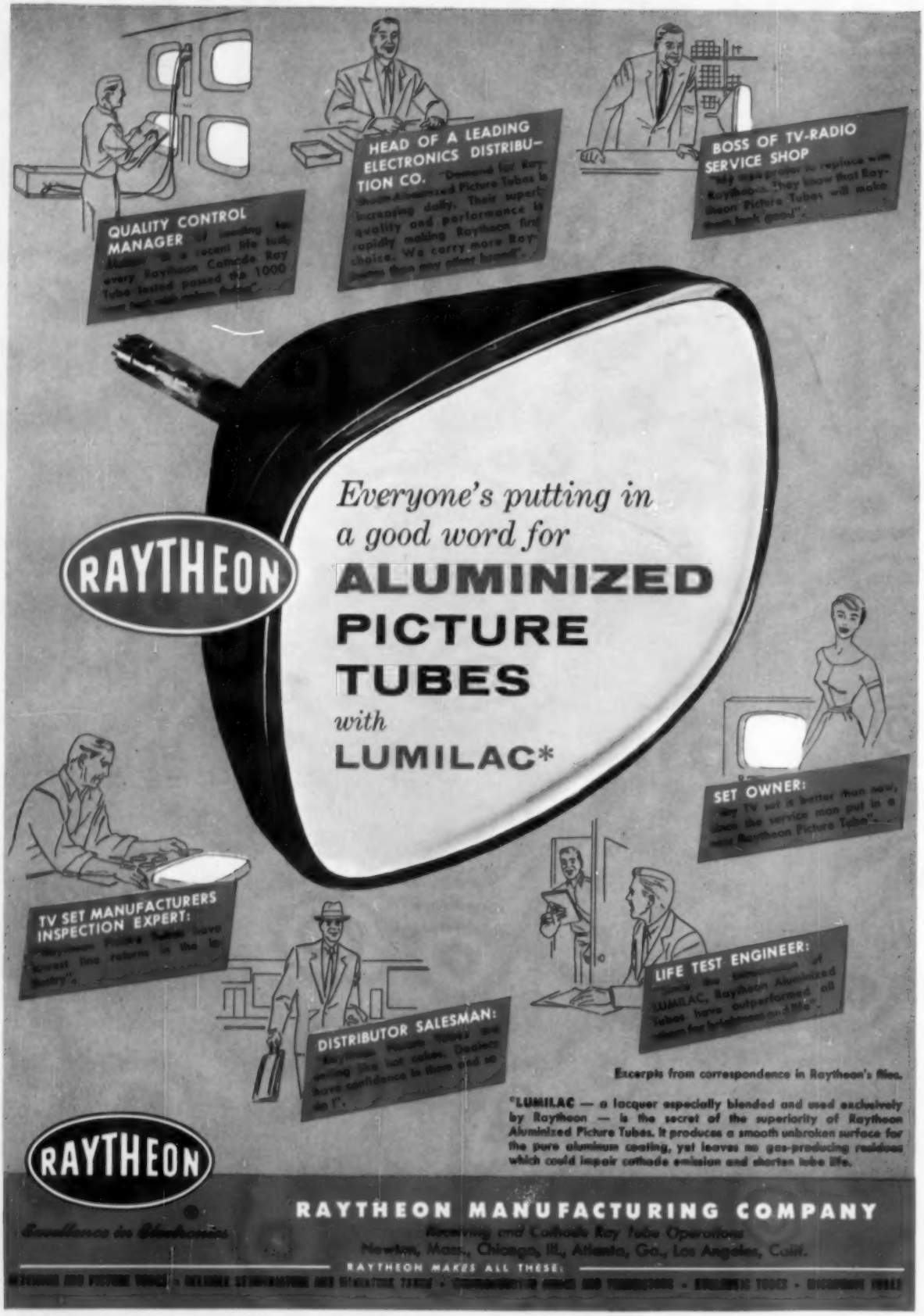
REVIEW OF NEW RECORD PLAYERS

RADIO & TELEVISION NEWS

OCTOBER
1955
35 CENTS
in U.S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE



Excerpts from correspondence in Raytheon's files.

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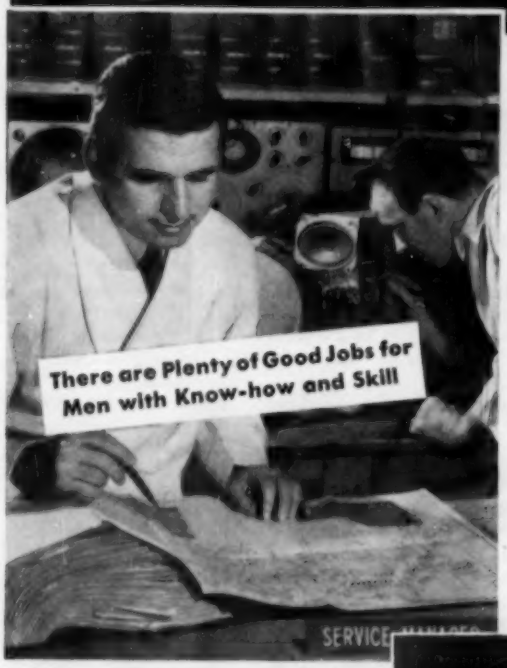

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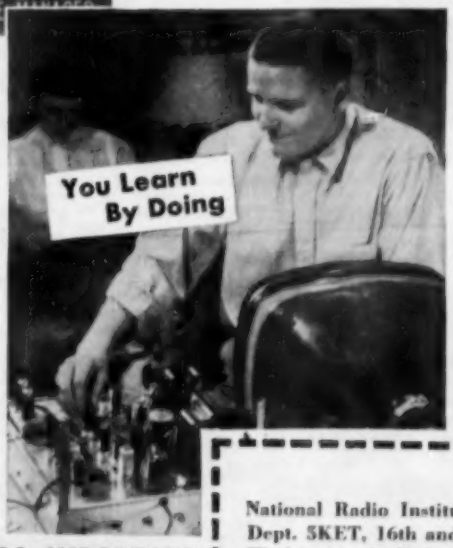

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COVER PHOTO: E. C. Herrington of National Company checks 8 kc. position selectivity curve during development of the company's new NC-300 amateur receiver. See pages 96-97. (Extachrome by National Company)

First in radio-television-audio-electronics

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VOLUME 54 • NUMBER 4

SUBSCRIPTION SERVICE: All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should allow at least four weeks for change of address. Include your old address as well as new—enclosing, if possible, an address label from a recent issue of this magazine.

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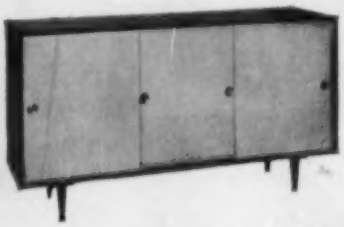
CABINART '56

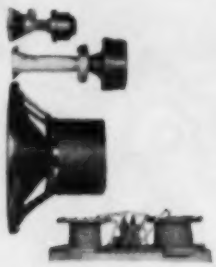
MODEL 10
MODEL 11
MODEL 21
MODEL 22
MODEL 27 ●
MODEL 28 ●
MODEL 27U ●
MODEL 28U ●
MODEL 65 ●
MODEL 70
MODEL 7112
MODEL 7115
MODEL 90
MODEL 91
MODEL 90U
MODEL 91U
MODEL 800 ●
MODEL 800U ●
MODEL KR-3
MODEL KR-3U
MODEL KR-4-12
MODEL KR-4-15
MODEL KR-5
MODEL KR-5-U
MODEL KR-5-P
MODEL ST-1 ●
MODEL ST-2 ●
MODEL ST-3 ●
MODEL ST-4 ●
MODEL ST-5 ●
MODEL ST-6 ●
MODEL ST-7 ●
MODEL ST-8 ●
MODEL ST-9 ●

MODEL 65



. . . storage for tape recorder, turntable, record changer, tuner, amplifier and speaker, if desired.

• 16 NEW EQUIPMENT CABINETS



THE Rebel 3 SPEAKERS

THE Rebel 4 SPEAKERS

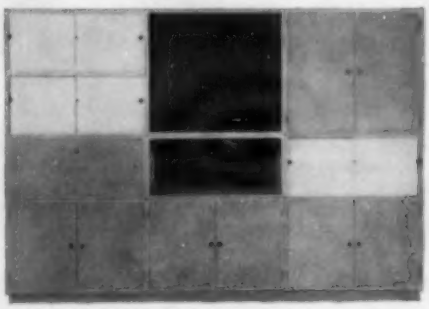
THE Rebel 5 SPEAKERS

CABINART SPEAKER SYSTEMS

KIT 27K ●
KIT 28K ●
KIT 80
KIT 8112
KIT 8115
KIT K-3 ●
KIT K-4-12
KIT K-4-15
KIT KST-1 ●
KIT KST-2 ●
KIT KST-3 ●
KIT KST-4 ●
KIT KST-5 ●
KIT KST-6 ●
KIT KST-7 ●
KIT KST-8 ●
KIT KST-9 ●

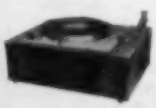
MODEL 27K
MODEL 28K

• TWELVE NEW HI-FI KITS



. . . EVEN A HI-FI STORAGEWALL

ACC-1
ACC-2
ACC-2U
ACC-3
ACC-4
ACC-5
ACC-6
ACC-7
ACC-7A



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For the RECORD.

BY THE EDITOR

SCATTER COMMUNICATIONS

A NEW term, familiar to the military, but almost unknown to readers of the technical press is fast reaching a prominence that may equal that of television or radar. It is "forward-scatter," a name applied to the mechanism encountered in radio wave propagation which now affords a remarkable new means of communication.

"Forward scatter" is the phenomenon of putting a v.h.f. or u.h.f. signal in an area, where under the classical definition, it does not belong. Waves between 40 and 80 megacycles will normally pass through the ionosphere without sufficient refraction to permit reception much beyond the immediate horizon. The military have found, however, that given a high e.r.p. these waves will return to earth between 700 and 1200 miles from the transmitter. The returned signal is garbled and not suitable for voice communication, but can be used for frequency shift keying or multiplexing. Signal strengths are weak and according to information available at this writing are received with a 99.9% reliability—something which cannot be done on any other channel out of the line-of-sight.

The military has taken advantage of this new system and currently has a link working between Maine and Thule, Greenland. Indications are available pointing to a v.h.f. link from Maine into Scotland and England. Should such a link be installed it will be the first time that propagation conditions have been better and shown greater reliability than the terminal transmitting and receiving equipment.

Such v.h.f. "forward scatter" is caused by ionospheric discontinuties in the upper D and lower E regions (50 to 65 miles above the surface). The u.h.f. "forward scatter," on the other hand, is caused by tropospheric discontinuties below 30,000 feet in altitude. The latter mechanism, which is theoretically related to ionospheric scattering, appears capable of traversing 200 to 250 miles. Unlike the garbled scatter from the ionosphere, the scatter from the lower atmosphere retains excellent fidelity. Recent announcements by the *Bell Labs* indicate that excellent TV signals have been consistently propagated over 200-mile hops.

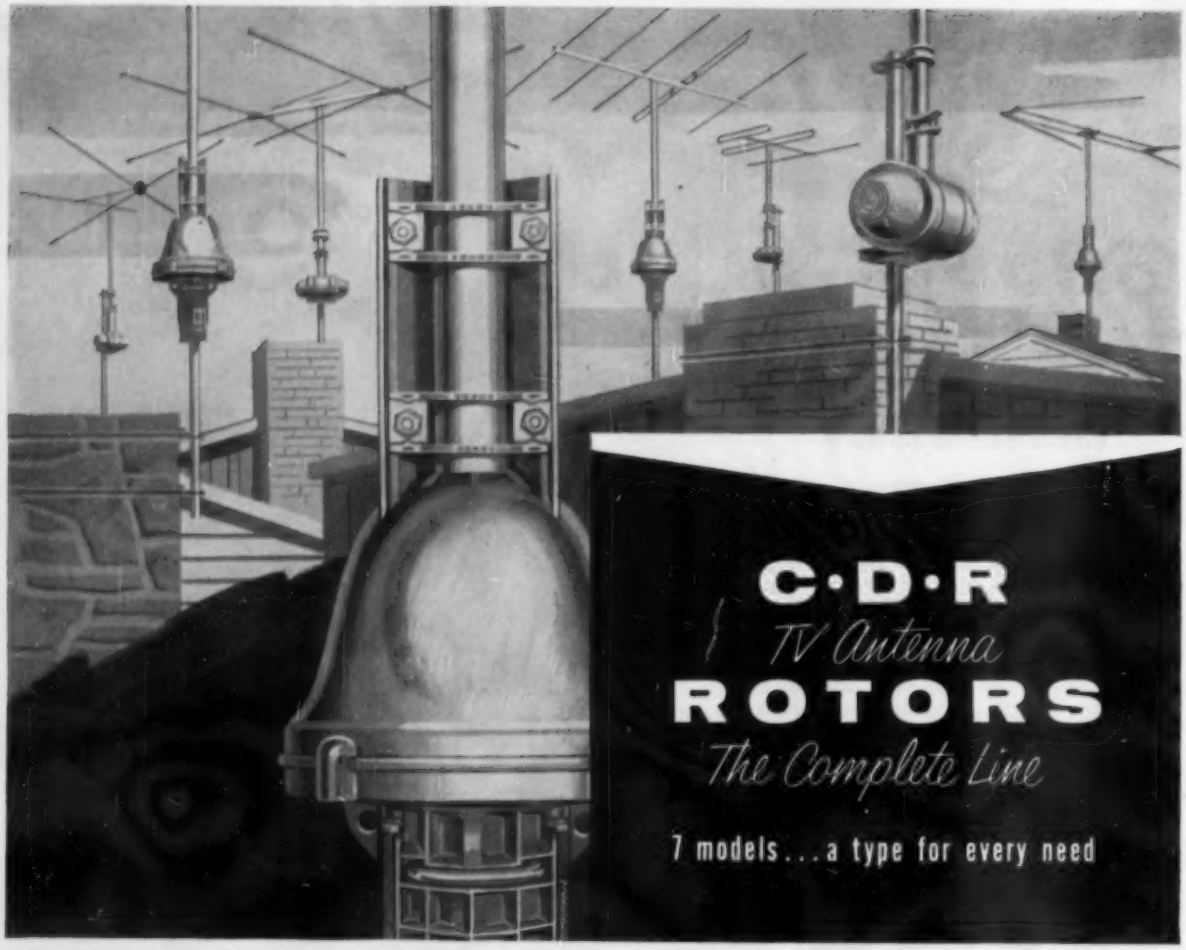
Initial experiments by the military with v.h.f. scatter took place on 49.8 megacycles between Cedar Rapids, Iowa and Sterling, Virginia. Numerous radio amateurs operating in the 6-meter band will recall the "big signals" on 49.8, 49.7, and 49.6 megacycles from 1952 to 1954. Analyses of the data obtained from these transmissions indicate that v.h.f. scatter is most effective between 40 and 80 megacycles.

The u.h.f. scatter appears to be effective over a tremendously wide range of frequencies — probably extending from at least 800 to 7500 megacycles. Some *Bell Labs* experiments have been made around 3700 megacycles and others at 5050 megacycles, both of which have proven to be equally efficient. At the present time the only limitation toward the greater use of u.h.f. scatter is terminal transmitting and receiving equipment.

Development and greater use of u.h.f. scattering will alleviate the burden of providing numerous microwave relay towers for transcontinental TV and telephone traffic. Development of "forward scattering" in the v.h.f. bands will solve many of the problems concerning circuit reliability. Thus both of these phenomena deserve the attention of our research personnel, but outside of the immediate use made of v.h.f. scatter by the military there appears to be little likelihood of its acceptance by the commercials operating medium range point-to-point circuits.

Obviously the military does not want to keep these developments to itself. Present frequency allocations, even as late as Atlantic City 1947, do not provide for the use of the v.h.f. by point-to-point services—especially by a then unheard of mode of propagation! Without this increased frequency utilization for 700 to 1200 mile point-to-point circuits the commercials will continue to suffer interruptions due to ionospheric storms and severe crowding, or even shortages. The problem is being very seriously studied.

Shifting of certain point-to-point services to the very-high-frequencies would give more channels to the aeronautical and maritime mobiles which are now in desperate need of additional frequencies between 5 and 20 megacycles. However, there are no channels set aside in the v.h.f. range of 40 to 80 megacycles for the "forward scatterers." The question then arises, is this valuable means of communication to be of advantage only to the military —or will the commercials eventually force the abandonment of the amateur radio 6-meter band (50 to 54 megacycles), or even the low-band TV channels 2 to 6 between 54 and 88 megacycles? . . . . . O.R.



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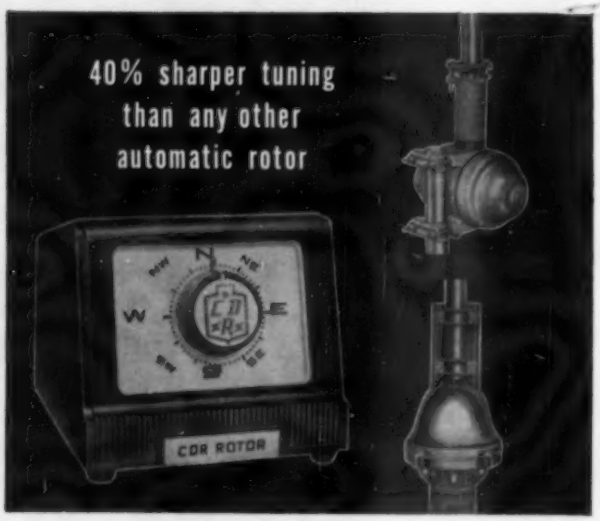
TR-4 The heavy duty rotor complete with handsome new, modern cabinet with METER control dial, uses 4 wire cable.

TR-12 Complete rotor INCLUDING thrust bearing. Handsome modern cabinet with meter control dial, uses 4 wire cable.

TR-11 Same as model TR-12 without thrust bearing.



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- ☐ Wagner's Overtures
- ☐ Mendelssohn's Concerto

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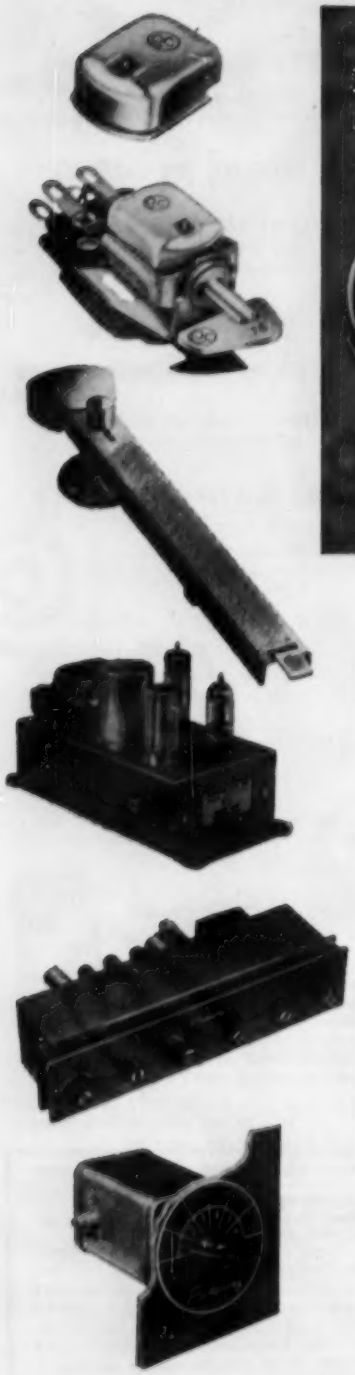

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"For those who can hear the difference"

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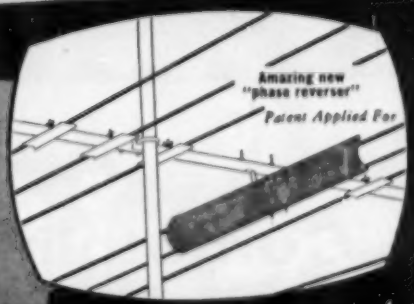
THE NEW WALSCO WIZARD

THE MOST ADVANCED, MOST POWERFUL

SUPER FRINGE ANTENNA

IN THE WORLD



here's positive proof!

Actual comparison of fringe antenna performance

Channels	Gain (db) Single Bay 2	4	6	7	9	11	13
Walsco Wizard – Imperial	6.1	6.9	8.2	11.9	11.6	10.8	12.6
Antenna "A" With 3 Phase Reversing Dipoles	6.3	6.6	8.1	10.5	10.2	10.6	12.4
Antenna "B" – Yagi Type with Phasing Loops	5.1	5.5	6.8	7.5	9.6	8.8	11.2
Antenna "C" – Yagi Type with Loading Coils	5.9	6.9	8.6	9.1	8.6	9.6	7.8

The new Walsco **Wizard** performs as 3 separate antennas combined in **one** to give the **very finest**, all-channel picture reception ever seen on any television screen. Extra dipoles, complicated harnesses, or phasing stubs are **completely eliminated**. And the **Wizard** is the easiest to assemble and install.

Walsco guarantees the Wizard for 3 years

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Wizard #4220	19.50 list
Wizard Imperial #4230	24.90 list

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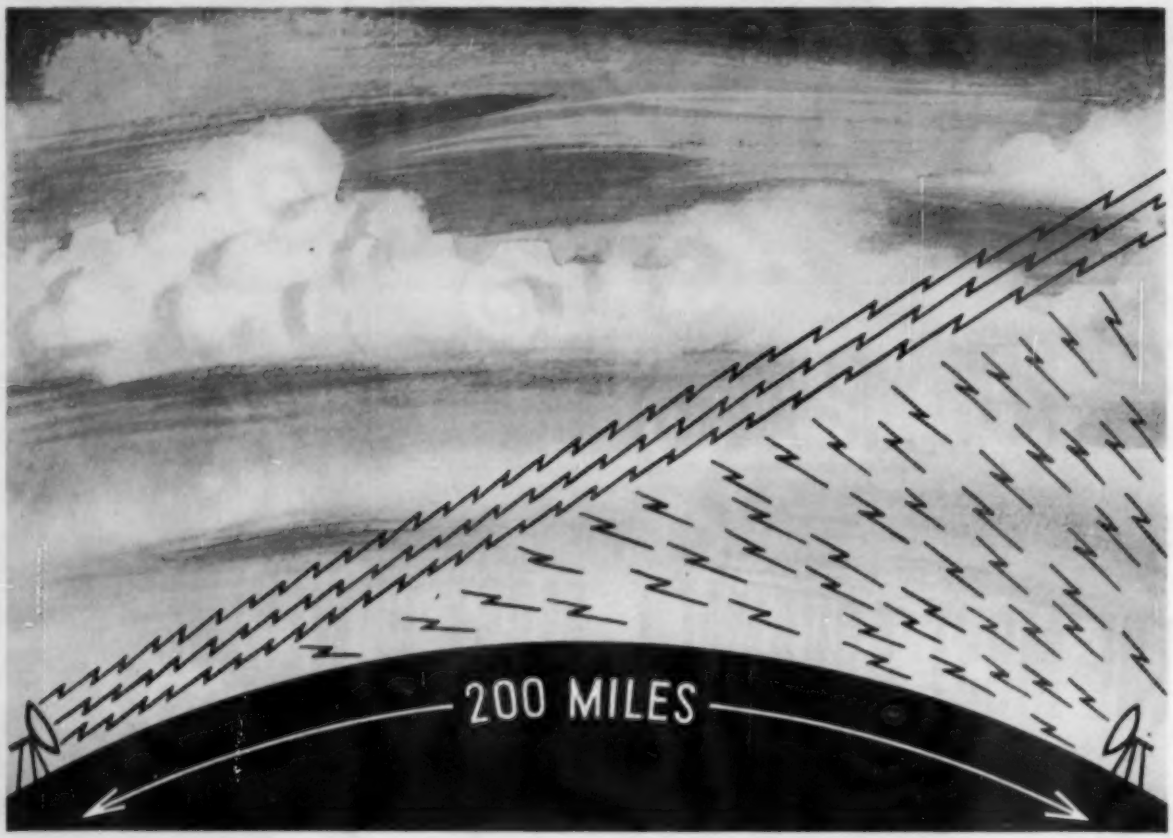
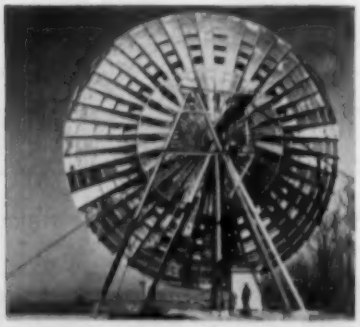


Highly schematic drawing illustrates the possible distribution of energy in ultra-high-frequency "over-the-horizon" transmission. The effect is similar to that of a powerful searchlight whose beam points into the sky. Light can be seen miles away from behind a hill even when the searchlight lens is invisible.

Something new on the telephone horizon



This experimental 60-foot antenna (rear view) photographed at Bell Laboratories in Holmdel, New Jersey, is designed for study of "over-the-horizon" phenomena.

Telephone conversations and television pictures can now travel by ultra-high-frequency radio waves far beyond the horizon. This was recently demonstrated by Bell Telephone Laboratories and Massachusetts Institute of Technology scientists using "over-the-horizon" wave propagation, an important recent development in the radio transmission field.

This technique makes possible 200-mile spans between stations, instead of the 30-mile spans used for present line-of-sight transmission. It opens the way to ultra-high frequencies across water or over rugged terrain, where relay stations would be difficult to build.

In standard microwave line-of-sight transmission, stations are so spaced that the main beam can be used. But now, with huge 60-foot antennas, and much higher power, some signals drop off this main beam as it shoots off into space. These signals reach distant points beyond the horizon after reflection or scattering by the atmosphere. The greater power and larger antennas of the "over-the-horizon" system permit recapture of some of these signals and make them useful carriers. The system will be a valuable supplement to existing radio relay links.

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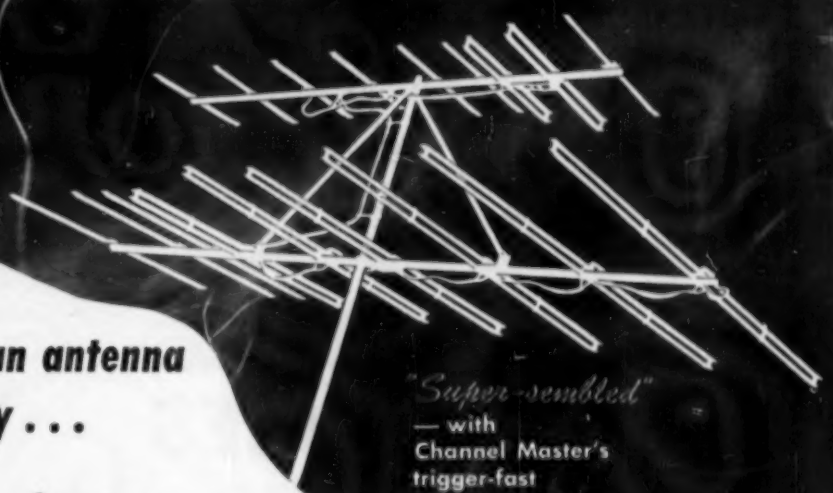
Improving telephone service for America provides careers for creative men in scientific and technical fields.



"Super-sembled" — with Channel Master's trigger-fast Snap-Lock Action.

Never before — an antenna with such utterly . . .

Fantastic front-to-back ratios

Low Band: from **15:1** to **50:1** relative VOLTAGE
(2500:1 relative *power*)

High Band: up to **13:1** relative VOLTAGE
(169:1 relative *power*)

new

CHANNEL MASTER'S "K.O."

all-channel antenna

Knocks out venetian blinds and co-channel interference!

Channel Master's new "K.O." has the highest front-to-back ratios ever recorded for any TV antenna! The sensational "K.O." actually sets up an INVISIBLE BARRIER to signals coming in from the rear. Working with supreme efficiency on both VHF bands, it totally REJECTS rear signals, preventing venetian blinds and other picture problems caused by co-channel interference.

Spectacular High Gain!

Low Band, 7 to 9 DB, single bay; High Band, 8.5 to 10.5 DB, single bay. True Yagi performance, combined with completely independent High and Low Band operation for maximum efficiency.

Available 3 ways!

Broad Band model—model no. **1023**
(includes HI-LO Matching Harness)
Low Band only—model no. **1026**
High Band only—model no. **1073**

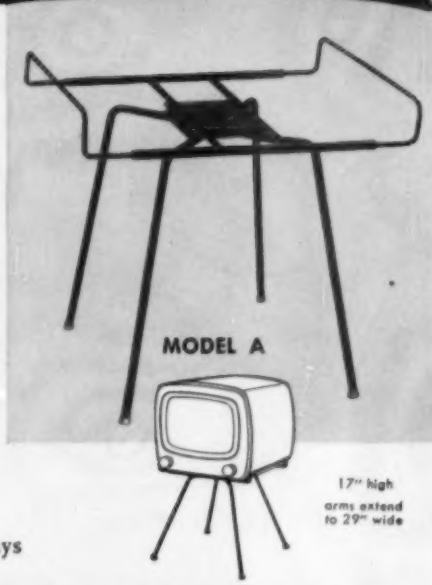
Full descriptive literature available from your Channel Master distributor.

LICENSED BY KAY-TOWNES ANTENNA CO., ROME, GA.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.
The World's Largest Manufacturer of TV Antennas and Accessories

SPECIAL! DIRECT-FROM-FACTORY LOWEST PRICE EVER OFFERED!

SWIVEL TV TABLES

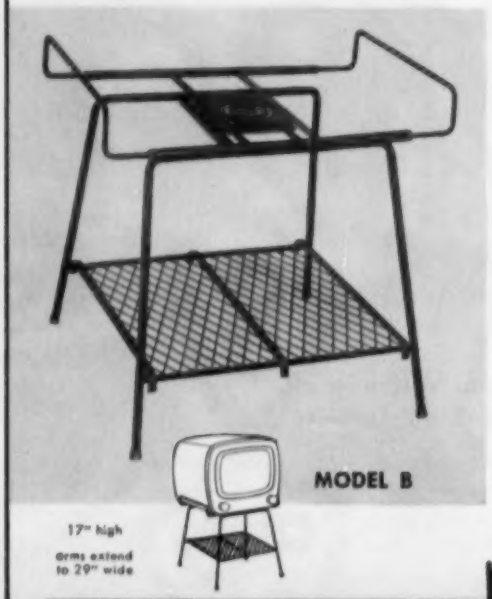


your cost only → **$2.10** EACH

FOB OUR FACTORY
KANSAS CITY, MO.

- Sturdy wrought iron
- Ball bearing swivel top
- Compare with any table selling at $6.98 retail!
- Minimum Shipment—12 tables Packed KD 4 to Carton
- Dun & Bradstreet rated accounts shipped open . . . all others send check with order.

TERMS: 2%—10 days



DELUXE TV TABLES

with ball bearing swivel tops and mesh trays

your cost only → **$3.00** EACH

FOB OUR FACTORY
KANSAS CITY, MO.

The New Look in TV tables! 16" x 16" mesh shelf, ball bearing swivel top. Compare with any table selling at $10.98 each!

Minimum Shipment—12 tables
Packed KD 4 to Carton

RUSH YOUR ORDER TODAY!
Use This Convenient Order Form!

JERROLD-STEPHAN CO., INC.
1954 UNIVERSITY AVE., ST. PAUL 1, MINN.

JERROLD-STEPHAN CO., INC., 1954 University Ave., St. Paul 1, Minn.

Please ship us the following TV Tables:

	Quantity		
MODEL A Swivel top		@ $2.10 each	SEND AD MATS ☐ CHECK IF DESIRED
MODEL B Swivel top and tray		@ $3.00 each	

TERMS: 2%—10 days

STORE NAME _____

ADDRESS _____

CITY _____ STATE _____

BY _____

THE GREAT NEW NAME IN ALUMINIZED PICTURE TUBES!

RCA "SILVERAMA" MEANS BRIGHTER, CLEARER, SHARPER TV PICTURES FOR YOUR CUSTOMERS—MORE REPLACEMENT BUSINESS, SALES AND PROFITS FOR YOU!

It's the great, new replacement line of RCA aluminized picture tubes and RCA is telling the world, your city and neighborhood about it. Radio & TV announcements, national magazines, direct mail, posters, streamers, counter cards and other powerful sales aids will bring the remarkable story of RCA "SILVERAMA" right into your customers' homes—bring customers into your store! Order RCA "Silverama" Aluminized Picture Tubes now. Your customers will ask for them. Get on board this new profit-maker!

SEE YOUR RCA TUBE DISTRIBUTOR TODAY FOR FULL DETAILS ON THE EXCITING RCA SILVERAMA WINDOW DISPLAY CONTEST FOR SERVICE DEALERS!

RCA®

RADIO CORPORATION of AMERICA

TUBE DIVISION HARRISON, N. J.

It's no accident that Du Mont's new Twin-Screen Hi-Lite picture tubes provide richer contrasts and sharper focus. They feature the sharp focus of the Hi-R gun design plus the extra brightness of an aluminized screen. Furthermore, *each* Twin-Screen Hi-Lite is purposely put through the same stringent tests to assure only the best of quality in outgoing products.

These outstanding uniform qualities are your guarantee that you always get a better picture tube when you specify Du Mont Twin-Screen Hi-Lite – And they cost no more than ordinary aluminized replacement types!

Ask your distributor for Du Mont "Twin-Screen Hi-Lite" the next time you buy picture tubes.

DU MONT

Cathode-ray Tube Division, Replacement Sales, Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

DU MONT
HI-R ELECTRON GUN

Exclusive with Du Mont! Recognized by customers and competitors alike as the finest gun available today.

J. E. SMITH
President
National Radio
Institute
Washington, D.C.
40 years of success
training men at
home in spare time.

I Will Train You at Home
for Good Pay Jobs, Success in
RADIO-TELEVISION

Practice Broadcasting with Equipment I Send

It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build. Get FREE sample lesson.

Practice Servicing with Equipment I Send

Self-confidence, security, earning power come from knowing-how and from experience. Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester, use it in conducting experiments, fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build. Judge for yourself whether you can learn at home in your spare time.

Television Is Growing Fast Making New Jobs, Prosperity

More than 30 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets and to operate hundreds of Television stations. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity, get started now learning Radio-Television at home in spare time. Cut out and mail postage-free card. J. E. Smith, President, National Radio Institute, Washington, D. C. Over 40 years' experience training men at home.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs Good Pay ***See Other Side***

Get My SAMPLE LESSON and 64-Page Illustrated Book
BOTH FREE

Cut out and mail card NOW!

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Mail card now!

NO STAMP NEEDED! WE PAY POSTAGE

Mr. J. E. SMITH, President
National Radio Institute, Washington 9, D. C.

Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

NAME.....AGE.....

ADDRESS.....

CITY.....ZONE.....STATE.....

VETS write in date of discharge.....

Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Television Broadcast Stations extend from coast to coast now with over 30 million Television sets already in use. Over 400 Television stations are on the air and there are channels for hundreds more. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc., is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

My Training Is Up-to-Date You Learn by Doing

Get the benefit of our 40 years' experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

More and more Television information is being added to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About this Tested Way to Better Pay

Read at the right how fellows who acted to get the better things of life are making out now. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television," because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage-free card can be an important step in becoming successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. Training Men for Over 40 years. Approved Member, National Home Study Council.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets

Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. The day you enroll I start sending you special booklets that show you how to fix sets. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

I TRAINED THESE MEN

Lots of Spare-Time Jobs

"I do a lot of spare-time Radio and TV servicing. It was fun learning and I don't know how to thank you." B. Goede, Plainview, Minn.

How TV Trouble Shooter

"I had only gone to 7th grade when I started course. Now have job as TV trouble shooter, also fix sets spare time." M. R. Lindemuth, Fort Wayne, Ind.

Engineer with WHPE

"Thanks to NRI, I operated a successful Radio repair store. Then I got a job with WPAQ and now am an engineer for WHPE." V. W. Worsman, High Point, N. C.

NRI Course Can't Be Beat

"Am with WCOC. NRI Course can't be beat. No trouble passing 1st class Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." William F. Kline, Cincinnati, Ohio.

Extra Money in Spare Time

"I am a police captain and also have good spare-time service business. Just opened my new showrooms and shop." C. W. Lewis, Pensacola, Fla.

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician, Service Manager, Tester, Servicoman, Research Assistant. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **AVIATION RADIO:** Plane Radio Operator, Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **TELEVISION:** Pick-Up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician. **POLICE RADIO:** Transmitter Operator, Receiver Servicoman.

SAMPLE LESSON and 64-Page BOOK BOTH FREE

CUT OUT AND MAIL POSTAGE-FREE CARD

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P.L. & R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
16th and U Sts., N.W.
Washington 9, D. C.

K L M O P R S T U W X

Have Your Own Business

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned in spare time. Joe Travers, a graduate of mine, in Asbury Park, N. J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

NOW... MODEL SX-100
SELECTABLE SIDE BAND RECEIVER
BUILT TO THE SPECIFICATIONS OF 1,000,000 FIELD EXPERTS

See it at Your Jobber—only $295.00

Hallicrafters 22 years of production know-how, the engineering experience of developing over 100 different major receiver designs, plus the advice of over 1,000,000 field experts operating Hallicrafters receivers all are combined to bring you this outstanding new receiver—the SX-100! Hallicrafters alone, long recognized as the leading designer and manufacturer of quality communications equipment, can offer you the dependability and performance of this great new SX-100 at the amazingly low price of just $295.00.

Look at these features you enjoy with the SX-100 . . . before, they were available only on receivers costing a great deal more!

1. SELECTABLE SIDE BAND OPERATION.
2. "TEE-NOTCH" FILTER—This new development provides a stable non-regenerative system for the rejection of unwanted hetrodyne. The "Tee-Notch" also produces an effective steepening of the already excellent 50 KC i.f. pass band (made famous in the SX-96) and further increases the effectiveness of the advanced exalted carrier type reception.
3. NOTCH DEPTH CONTROL for maximum null adjustment.
4. ANTENNA TRIMMER.
5. PLUG IN LABORATORY TYPE EVACUATED 100 KC QUARTZ CRYSTAL CALIBRATOR—included in price.
6. LOGGING DIALS FOR BOTH TUNING CONTROLS.
7. FULL PRECISION GEAR DRIVE DIAL SYSTEM.
8. SECOND CONVERSION OSCILLATOR CRYSTAL CONTROLLED—greater stability through crystal control and additional temperature compensation of high frequency oscillator circuits.

Controls

Pitch Control
Reception
Standby
Phone Jack
Response control (upper and lower side band selector)
Antenna Trimmer
Notch Frequency
Notch depth
Calibrator on/off
Sensitivity
Band Selector
Volume
Tuning
AVC on/off
Noise limiter on/off
Bandspread
Selectivity

hallicrafters

CHICAGO 24, ILLINOIS

Model SX-100. *Amateur Net* $295.00
Matching R-46B Speaker $17.95
***Frequency Range* 538kc-1580 kc**
1720 kc-34 mc

Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE WAVERING CONGRESSIONAL investigation of the ultra-highs, channel clearances, demixing, and networking, recently targeted for a full-bloom start this fall, has once more been flagged off the road and berthed until the beginning of the year; perhaps the second or third week of January. The postponement was blamed on the woeful lack of interest among members of the Senate Interstate and Foreign Commerce Committee, charged with the responsibility of conducting the probe. Commenting on this irksome situation, the Committee's chairman, Senator Magnuson, said that he just couldn't round up enough members of the committee to sit in on a hearing this fall. The Commission was also cited as a cause for the delay, with criticism aimed at the tabled decision

(*Continued on page* 24)

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Pennsylvania	Pittsburgh	WIIC	11	198-204	286

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Wisconsin	Whitefish Bay	WITI-TV	6	82-88

CALL LETTER CHANGES

Kansas	Wichita	KARD-TV (Formerly KTVR)	3	60-66
Wisconsin	Milwaukee	WISN-TV (Formerly WTVW)	12	204-210

*ERP = (effective radiated power, kw.)

NEW TV STATIONS ON THE AIR

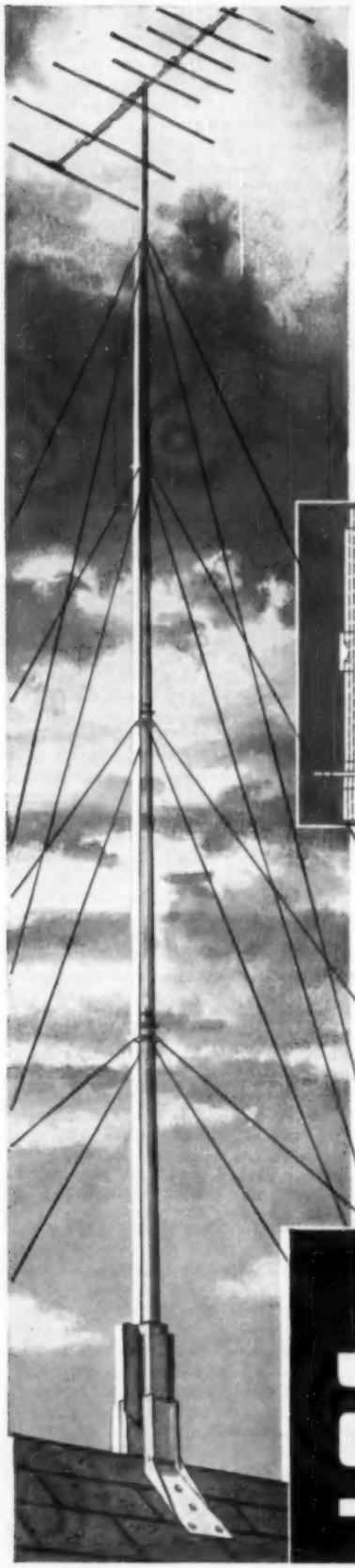
(As of September 25, 1953)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Alabama					
Mobile	WKRG-TV	8	76-82	12.74	100
California					
Sacramento	KCRA-TV	3	60-66	16.06	100
Florida					
Daytona Beach	WFMJ-TV	2	54-60	17.8	1.26
Kansas					
Wichita	KARD-TV	3	60-66	16.06	100
Louisiana					
Shreveport	KTBS-TV	3	60-66	16.06	100
Nebraska					
Hastings	KHAS-TV	8	76-82	12.74	100
North Carolina					
Washington	WITN-TV	7	174-180	5.61	316
Texas					
Fort Worth	KFJZ-TV	11	198-204	4.93	200
Lufkin	KTRE-TV	9	186-192	5.25	28
West Virginia					
Huntington	WHTN-TV	13	210-216	4.65	316
Canada					
St. Johns, Newfoundland	CJON-TV	2	54-60	17.8	21.04

WQXI-TV, channel 36, Atlanta, Georgia; WNEX, channel 47, Macon, Georgia; WEEU-TV, channel 33, Reading, Pennsylvania; and WNET, channel 16, Providence, Rhode Island, have gone off the air. WTOV-TV, channel 27, Norfolk, Virginia, is now back on the air. WMVT, channel 3, Burlington-Montpelier, Vermont, has changed its call letters to WCAX-TV. WTVW, channel 12, Milwaukee, Wisconsin, has changed its call letters to WISN-TV.

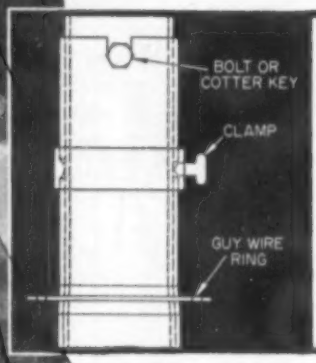
The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 452 (116 of which are u. h. f.).



New concept in telescoping TV masting ... utilizes J & L Perma-Tube

REDUCE YOUR TV MAST COST OVER 20%

Use high-strength, corrosion-proof J & L Perma-Tube 10-foot telescoping sections to easily construct 30 to 50-foot masts



Only J&L Telescoping Perma-Tube offers:

- **Joint design which provides instant field assembly**
- **Machine-fitted joints that insure close tolerance for high strength and rigidity**
- **Guy wire ring position that eliminates all binding and guy wire interference**

No longer is it necessary to buy expensive, ready-made masts. Now you can "tailor-make" your own with standard 10-foot lengths of 16-gage J&L Perma-Tube—and save money.

It's available in cartons from your local distributor in five diameters. The largest base section OD is 2¼ inches and each telescoping section is ¼-inch smaller, the smallest section having an OD of 1¼ inches.

J&L Perma-Tube in the 1¼-inch size can be used interchangeably as a fitted-joint section for smaller masts or as the smallest and topmost piece of longer telescoping masts.

Corrosion-proof J&L Perma-Tube is treated with Vinsynite—then coated both inside and outside with a metallic vinyl resin base. It successfully passes ASTM's 500-hour-minimum salt spray test—which guarantees Perma-Tube's longer life on the job.

Sturdy J&L Perma-Tube is made of a special, high-strength, J&L-produced steel. A 10-foot section of 1¼-inch diameter by 16 gage can support a weight at its center point of 200 pounds with a minimum of deflection and permanent set.

Order these new telescoping sections along with your regular 1¼-inch J&L Perma-Tube. Hardware—cotter keys or bolts, clamps and guy rings—may also be secured from your local distributor. For more information write J&L direct.

J&L STEEL

Jones & Laughlin
STEEL CORPORATION – *Pittsburgh*

on the question of selective demixing of channels.

Firing away at the FCC, the Senator said: "The Commission has a real and moral responsibility to inform the public as quickly as possible as to what it expects to do about . . . de-intermixture. . . . Every day the Commission delays such a pronouncement, large sums of money continue to be invested by the public in converting or purchasing sets so that u.h.f. signals may be received. Yet, if the experience of the past two years is any guide, many of these people may be making a futile expenditure . . ."

The Commission, continued the committee's headman, has been told on many occasions that the official probe is not to be . . . "used as a device for delaying the discharge of its responsibilities in regulating the broadcast field in the public interest."

Another complication, which it was said had contributed to the temporary shelving of the TV study, was the resignation of the committee's majority counsel. Although ill health was given as the official reason for the resignation it was felt that actually the attorney left his post because his investigation plans were strongly opposed by the Republican members of the probe group. Sidney Davis, the resigned counsel, had proposed that the investigation should not only cover an engineering allocations study, but network ties with advertisers and agencies, rates, discounts, multiple ownership, program packages, and other allied problems.

The Davis post will be filled, temporarily, by none other than former Senator Clarence Dill, one of the architects of the old Federal Radio Commission and co-author of the Communications Act of '34.

In the meantime two groups outside of Congress have been asked to study engineering phases of the allocation problem and networking. For the technical job, there's an *ad hoc* engineering group, consisting of the nation's foremost broadcast technical and administrative experts, who will attempt to resolve a number of puzzling questions, as to whether the present v.h.f. band should be extended by adding more channels, or the allocation schedule should be completely reshuffled, or directional antennas should be permitted, or channels should be dropped in at the upper end of the lower v.h.f. bands, or selective demixing should be authorized. The network assignment has been given to a four-man FCC panel, consisting of Chairman George C. McConnaughey and Commissioners Rosel Hyde, Robert Bartley, and John Doerfer; they have turned the job over to staff members of the Commission, who will study, it is believed, the Plotkin and Jones reports prepared for the Senate committee. The Plotkin memo, covering the business practices of networks and syndicates, charged the networks as "quasi-monopolistic" and suggested that the

(*Continued on page* 161)

SYLVANIA SILVER SCREEN 85

more profit for you in "Silver Screen 85's"

Stepped-Up Selling Power

Sylvania puts you in the driver's seat and backs you with more promotional horsepower than ever before. This Fall, it's *all out on all fronts* to make your selling job easier and your servicing job more profitable. Here's how:

Stepped-up TV power—"Beat the Clock's" fabulous prize contest makes all your customers and prospects potential prize winners. 10 new prizes, 10 new winners every week. Week after week you'll win new customers who come to you for their free entry blank. And as a Sylvania Dealer only you can supply them with an official entry blank.

Stepped-up magazine power—Sylvania's selling the "Silver Screen 85" in the biggest consumer magazine campaign of 1955. Full schedules in *This Week* and *TV Guide* will presell your customers on the three outstanding features of the "Silver Screen 85" picture tubes. 11 million readers are reached by *This Week* through the combined distribution of 35 great American newspapers. Over 3 million TV viewers use *TV Guide* every week for TV news and program listings.

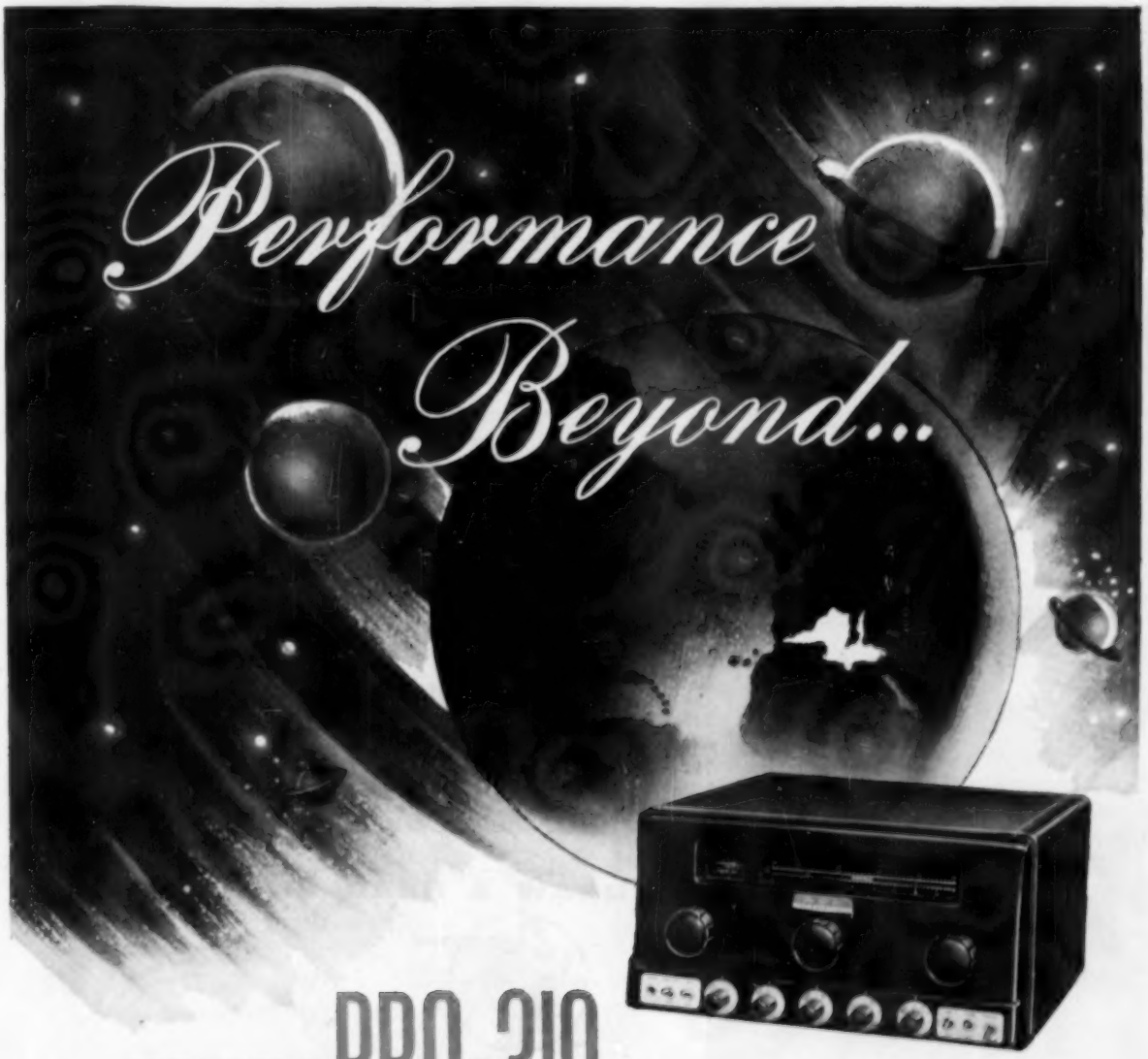
Stepped-up promotional power for you. A complete package of Sylvania promotion material is available so you can fill in the important final link in this promotional chain reaction. Window and counter displays, new direct-mail material, the important "Silver Screen 85" booklet, and new ad mats are included to help you capitalize on the prize contest and national magazine program.

Stepped-up profits for you. Sylvania supplies selling power that adds up to more profit for you. Think with Sylvania—work with Sylvania—promote with Sylvania—and you can't help but profit with Sylvania.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal
LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

SYLVANIA®

...fastest growing name in sight



THE NEW PRO-310

If you want a really fine receiver . . . one that will give you finer performance beyond any other you've operated, you want the new PRO-310.

The most distant stations are brought to you with a maximum of clarity and a minimum of interference. In fact, you'll find the PRO-310 offers you both short wave and standard broadcast listening that is unsurpassed. And, the tremendous logging capabilities of the PRO-310 allows you to return to the same station again and again without searching and tuning.

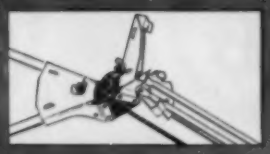
Three years of intensive design and research engineering went into this superb receiver plus the Hammarlund "know-how" developed by making thousands of sets for government service.

So, if you demand the finest performing equipment available, look the new PRO-310 over. If your dealer doesn't have one now, he'll get his stock soon. Write to The Hammarlund Manufacturing Co., Inc., 460 West 34th Street, New York 1, New York for a free copy of our pamphlet "The PRO-310 Story", which describes the engineering and planning that went into this magnificent instrument.

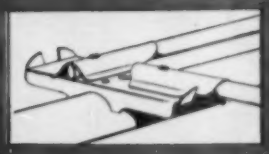
HAMMARLUND

TRIO®

Will Not Sacrifice Quality FOR PRICE!



Insta-Lok Head—216% more resistance to vibration and breakage. Flip out elements —they're locked in place.



Insta-Lok Clamps bring elements into position—that's all

TRIO Sharpshooter CONICAL $3.95 LIST

14 POPULAR MODELS —ALL COMPLETELY PRE-ASSEMBLED

Quality materials plus advanced TRIO automation give you the finest conicals ever built.

Sharpshooter's Quality Features Obsolete Un-assembled Antennas

TRIO Sharpshooter YAGI

DRAW A BEAD ON QUALITY

Only TRIO SHARPSHOOTER Yagis Have These Quality Features

INSTA-LOK CLAMPS—Perfect alignment, positive lock, superior strength, lessened vibration and breakage. No finer yagis regardless of price!

EFFICIENT ELECTRICAL DESIGN—TRIO high channel models use a ratio type dipole for better impedance match, higher gain, sharper directivity.

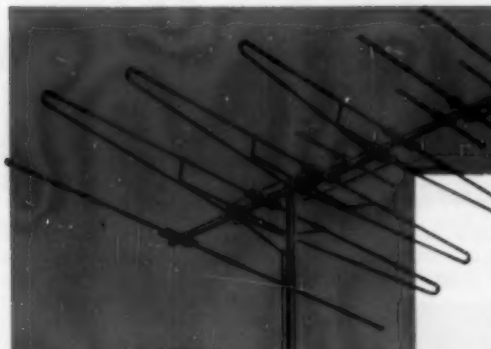
RIVETED CONSTRUCTION—Introduced by TRIO for faster assembly, better picture quality.

BETTER VALUE—Because TRIO produces practically every part used in their products, including their own aluminum tubing.

Ask your distributor for complete literature on the new SHARPSHOOTER Conicals and Yagis.

TRIO® Manufacturing Company
GRIGGSVILLE, ILLINOIS

EXPORT SALES DIV., SCHEEL INTERNATIONAL INC., 4237 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARSCHEEL



ANNOUNCING THE

Trio Zephyr Royal

THE FIRST STAGGER-TUNED TELEVISION ANTENNA

What Hi-Fi brings to Audio Stagger-tuning brings to TV Antennas!

The ZEPHYR ROYAL employs three "wing" dipoles, stagger-tuned, to provide even higher and more uniform gain, absolute flat response on all channels 2–13—a necessity for color TV. It is tuned on six predetermined frequencies in the same way that stagger-tuned circuits are used in I.F. stages in TV receivers.

The ZEPHYR ROYAL is not just an addition to the famous TRIO ZEPHYR, but is a completely new electrical design. Parasitic elements are used ONLY where they contribute to the efficiency of the antenna's electrical design—not just for promotional purposes.

A new phasing method provides increased directivity—and functions equally well on the highs as well as the lows.

The elimination of minor lobes, to an extent never before realized in an all-channel antenna, finally banishes all co-channel interference. All of the gain is packed into one efficient forward lobe.

Try a new TRIO ZEPHYR ROYAL. You'll find that in gain and directivity it's the bust all-channel TV antenna ever produced for color or black and white.

Pre-Assembled—Uses TRIO's famous Insta-Lok Clamps. Sturdy—Rugged—Compact and it's patented too!

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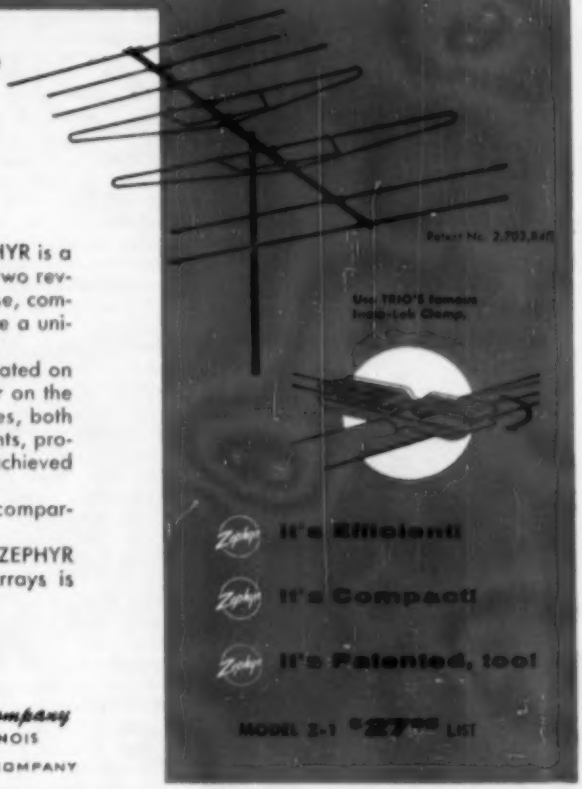
There's sharp directivity too, on all channels—comparable to a yagi.

TRIO believes that with the introduction of the ZEPHYR and the ZEPHYR ROYAL, the need for stacked arrays is eliminated.



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Within the Industry

JOHN BENTIA has been named president and general manager of *Alliance Manufacturing Company*. He was elected to the post by the officers of *Consolidated Electronics Industries Corporation*, new owners of *Alliance*. He was also made a director of *Alliance* and a vice-president of the parent firm.

In addition to Mr. Bentia, officers of *Alliance* are: Aries Vernes, vice-president; R. D. Dettmer, secretary; Robert Dunn, treasurer; and R. E. Barrick, assistant-treasurer. Pieter van den Berg is president of the parent company.

* * *

STANDARD COIL PRODUCTS CO. INC. has announced the formation of a wholly-owned Canadian subsidiary, **STANDARD COIL PRODUCTS (CANADA) LIMITED**. The firm will operate in a newly-acquired 30,000 square foot plant in Toronto . . . **VALLEY ELECTRONICS** has been established as a wholesale parts distributor at 1735 E. Joppa Rd., Towson, Maryland. Al D'Urso, former distributor sales manager of **SARKES TARZIAN'S** Rectifier Division heads the new firm . . . **STEWART-WARNER CORPORATION** has acquired the entire business and assets of **JOHN W. HOBBS CORPORATION** of Springfield, Illinois . . . **PERFECTION MICA COMPANY** has announced the creation of the Magnetic Shield Division to manufacture its new magnetic shielding material . . . **NEWARK ELECTRIC COMPANY** has established an industrial sound department under the direction of Richard C. Wells. The department will service industrial plants, schools, and institutions.

* * *

W. HAYES CLARKE has been named national accounts sales manager for the *General Electric Company* Tube Department.

He will have charge of planning and sales of electronic tubes to equipment manufacturers on a national scale. He will return to Schenectady from Clifton, N. J. where he has been eastern regional sales manager since 1953.

Mr. Clarke has been with *General Electric* for 21 years, having been manager of radio and tube sales for the *G-E Supply Corporation*, sales manager for the "Musaphonic" radio line, and in marketing positions in the tube department since its organization 10 years ago.

* * *

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION has announced the formation of a Dry Battery Section within the national group.

Abraham I. Barash, executive vice-president of *Bright Star Industries* of Clifton, N. J., was elected chairman of the section; Fred J. Kirkman, executive vice-president of *Burgess Battery Company*, Freeport, Ill., was named vice-chairman, and F. J. Wolfe, manager of the quality and specifications division of *National Carbon Company* was chosen chairman of the general engineering committee.

Representatives of nine dry battery manufacturers attended the organizational meeting.

* * *

DR. BENJAMIN H. ALEXANDER has been appointed manager of *CBS-Hytron's* Semiconductor Operations with headquarters at the company's Lowell, Mass. plant.

He is a pioneer in the semiconductor field and has also participated extensively in classified work for the Atomic Energy Commission. He is a member of the American Society of Metals, the American Institute of Metallurgical Engineers, and the Institute of Metals (England).

Before joining *CBS-Hytron*, he was engineering manager in charge of semiconductors at *Sylvania Electric Products Inc.*

* * *

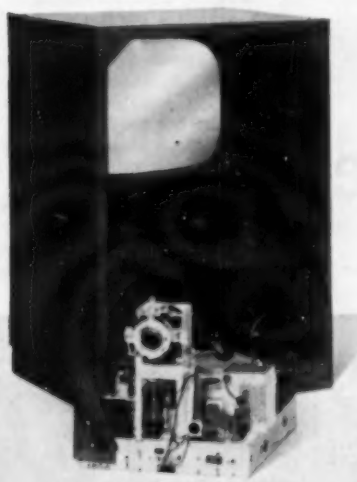
OLSON RADIO WAREHOUSE, INC. has opened a new store at 711 Main Street, Buffalo, New York, under the managership of Cleon Billings to service the Western New York State area and Southern Ontario . . . **THE FILTRON COMPANY, INC.**, manufacturer of electronic components, has opened a new West Coast plant at 10023 West Jefferson Blvd. in Culver City, California. Over 10,000 square feet of floor space will be used for research, testing, and production . . . **YOUNG & YOUNG**, electronic wholesaler of Springfield, Lawrence, and Fitchburg, Massachusetts, has opened another wholesale outlet at 33 Bradford St., Pittsfield, Mass. . . . The Government & Industrial Division of **PHILCO CORPORATION** has moved its West Coast and Pacific Northwest Regional sales office to Suite 417, 1355 Market Street, San Francisco 3, Cali-

She: *But, how do I know this is a good tube?*

You: *Because, this is a CBS aluminized Mirror-Back picture tube. There aren't any better.*

She: *And I see it has the Good Housekeeping Guaranty Seal, too. That's proof enough for me.*

Customer confidence really counts when it comes to the big tube. That's when CBS tube advertising helps you most. For CBS tubes have the Good Housekeeping Guaranty Seal and are nationally advertised to 76.9% of your customers . . . the women of America. And 53% of these women are influenced in their purchases by that seal of approval. You protect yourself and gain your customer's good will when you install a new CBS aluminized Mirror-Back picture tube.



Show her the CBS carton with the Good Housekeeping Guaranty Seal.

CBS-HYTRON, Danvers, Massachusetts . . . A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

fornia . . . **COOK ELECTRIC COMPANY** of Chicago has opened a new district office at 6405 East Kellogg in Wichita, Kansas, with E. W. Wilbert in charge . . . **STEPHENS MANUFACTURING CORPORATION**, California manufacturer of speakers and microphones, has set up warehousing facilities at 105 South Arlington, Akron 6, Ohio, to take care of its customers east of the Mississippi. **ELECTRONIC PRODUCTS WAREHOUSING** will handle the distribution for the speaker company . . . **ATLAS COIL, INC.**, has moved to new quarters at 205 Main Street, Ansonia, Conn. . . . **H. H. BUGGIE, INC.**, has consolidated all of its facilities at a new plant located on a 47 acre tract on Route One, near Millbury, Ohio. The firm's mail address will be Box 817, Toledo 1, Ohio . . . **ASTRON CORPORATION** of East Newark, N. J., has established warehousing facilities on the West Coast to provide faster service to Coast manufacturers. Orders placed with local West Coast distributors will be filled from the new warehouse stock . . . **POTTER INSTRUMENT COMPANY, INCORPORATED**, of Great Neck, New York, has expanded production facilities to include an entire new building on Great Neck Road . . . **KAY-LAB** has moved to a new location at 5725 Kearney Villa Rd., San Diego 12, California . . . **VOKAR CORPORATION** is tripling plant area by construction of a new plant. The new building will connect two separate wings of the present plant in Dexter, Michigan . . . The Washington, D. C., district office of **AMPEX CORPORATION** has been moved to 8033 13th Street, Silver Spring, Maryland . . . Plans for expanding receiving tube facilities by construction of a new building at Owensboro, Ky., have been announced by **GENERAL ELECTRIC COMPANY'S** Tube Department. Occupancy is planned for shortly after the first of the year.

* * *

CURTIS B. HOFFMAN has been appointed vice-president-sales of *Brush Electronics Company*, Cleveland manufacturer of magnetic recording heads and piezoelectric crystals.

In addition to his administrative duties, Mr. Hoffman will direct the marketing of the company's industrial and research instruments, electronic components, and new electronic memory devices. He was most recently associated with *Foote Bros. Gear and Machine Corporation* of Chicago as assistant to the president.

* * *

C. A. SWANSON has been named general sales manager of *Standard Coil Products Co. Inc.* succeeding **LOUIS MARTIN** who has resigned. **ODEN F. JESTER**, sales manager of the firm's distributor division, will assume the added duties of assistant general sales manager . . . **KEN R. GERLACH** is the

(*Continued on page* 108)

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NOW THREE HOME STUDY COURSES . . . prepared by instructors of RCA Institutes, engineers from RCA Laboratories, and training experts of the RCA Service Company. Clearly written . . . easy to understand . . . the same high caliber instruction as given in the resident classrooms of RCA INSTITUTES.

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NEW TV KIT AVAILABLE WITH COURSE II—there is no better way to learn than by *doing* and RCA Institutes has developed a large-screen TV KIT available to home study students to build while taking Course II. It has the most modern up-to-date circuitry, actually enabling you to apply at home all the latest servicing techniques.

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"Swing In" type; 3½", 9" strap

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TELCO "KANT-STRIP" STAND-OFF

Round insulator, 3½" 9" strap

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TELCO 3-WAY STAND-OFF

For 3-line use, 7½" wood screw

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Welded 10-23 nut, 3½", 9" strap.

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Tougher, inline duplex; 7½", 9" strap.

No. EZ-8258-N $0.24

TELCO CHIMNEY QUICK MOUNT

Easy to install, complete

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TELCO SNAP-IN CHIMNEY MOUNT

Fits masts to 1¼" complete

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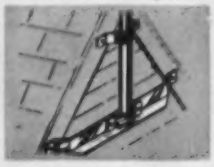

TELCO PEAK MOUNT

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Extra sturdy, 12" clearance

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Easy to install; UL approved

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Handsome 12" globe plus built-in antenna

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Universal type, UL approved

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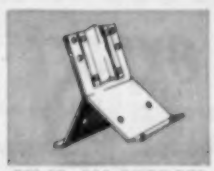

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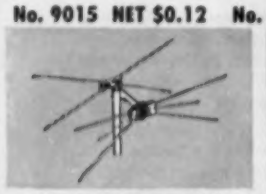

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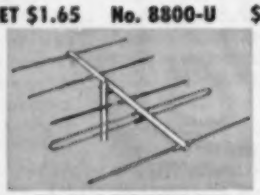

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Covers channels 2 through 83.

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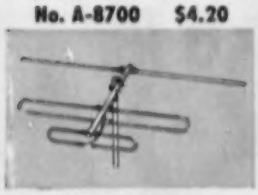

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Channels 7-13, ½" seamless elements

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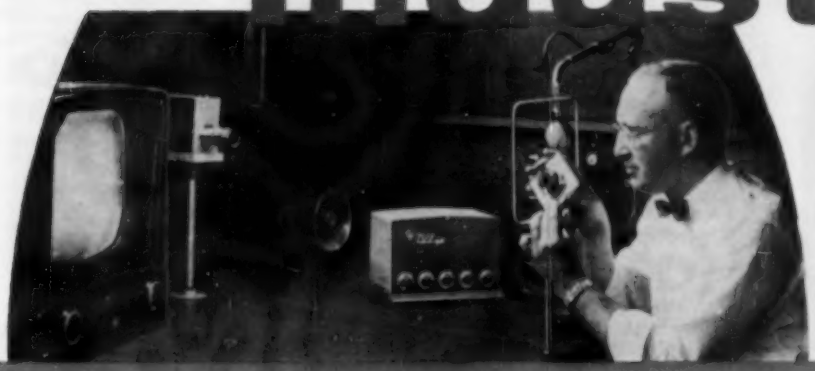
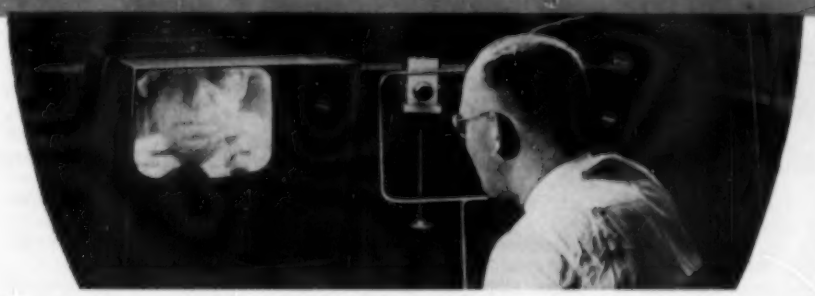
Industrial TV



Watchmakers at the Bulova Watch Company use RCA "TV Eye" equipment between the engineering and production departments in order to check watch parts and blueprints.

By WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS



Closed-circuit TV is really booming and offers vast growth possibilities. You may fit into this picture!

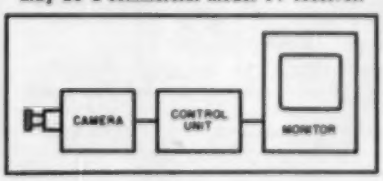
THE prediction was recently made that in another five years more closed-circuit TV systems will be in operation than home receivers. Although this seems a very optimistic prophecy, the facts of the case point to a saturation of the home receiver market, while the industrial TV business is growing at an unbelievable rate.

Recently, a bank investigated the cost and feasibility of installing a system which would permit the manager in his office to verify checks and other documents directly from the main business floor. When informed that the entire installation would cost about $2500, bank officials explained that this was really cheap since the salary, social security, tax, and welfare benefits for a messenger amounted to over $3000 per year. The TV system does not waste time walking, does not take time for lunch, and will last almost indefinitely. Even with the cost of maintenance and tube replacement, the difference between a closed-circuit TV system and a messenger was so great that the bank officials immediately ordered the TV system.

Private industry need only be shown where and how a TV system saves money and increases efficiency, and in almost every instance management is eager to install such a system. There are two major factors which have made industrial TV so acceptable and which will sustain its rapid growth. One is the relatively low cost; a complete camera and control unit including all sweep circuits and power supplies can be obtained for about $1000. The second factor is the simplification of the equipment which makes for low maintenance cost and easy installation. As will be shown here, the number of tubes as well as the power required is little more than that used in home TV sets. Servicing does not require transmitter engineering personnel, any TV service technician can tackle most of the work. This permits local industries to obtain immediate servicing, independent of the equipment manufacturer's service which may be days or weeks away.

This article will stress the special aspects of closed TV systems where the technical details differ from home receiver practice, and also point out a number of unusual applications of industrial TV. In every instance, closed-circuit TV provides either a new service or else improves the existing process substantially. While the examples given here represent widely different fields, it should be kept in mind that in each instance the installation represents a large number of similar installations throughout the country, throughout the industry. One example is the railroad installation. Although quite a few are now in use, thousands of identical installations are predicted for railroad stations across the country.

Fig. 1. Basic three-unit closed-circuit TV system. In many cases, the monitor may be a commercial model TV receiver.



Basic System

Fig. 1 shows, in block diagram form, the most basic closed-circuit TV system. It consists of a camera, sync generator, and monitor, with associated power supplies. Most of the simple systems provide the sync generator, power supplies, and monitor all in one unit. A typical 2-unit system is shown in Fig. 10. The camera is relatively small and the monitor is about the size of a table model home receiver. The number of controls is essentially the same as for a home receiver.

A functional block diagram of such a system is shown in Fig. 4; note that the same circuit which generates the vertical sweep for the monitor also supplies the vertical sweep signal for the camera tube. The same applies to the horizontal sweep and the "B+" supply. Since the horizontal and vertical sweeps for the camera and monitor are the same, there is no need for sync pulses, sync circuits, or critical adjustments. If the horizontal saw-tooth generator, for example, drifts slightly, the number of actual lines in the picture will change, but the change will

Fig. 2. Closed-circuit TV camera mounted on a microscope for more convenient viewing of microscope phenomena, also used for classroom projection of microscope slides for demonstration purposes.

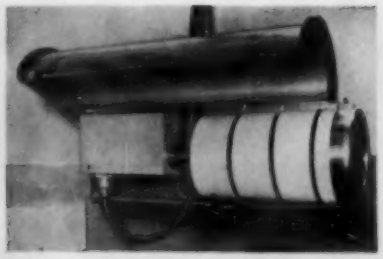


Fig. 3. Closed-circuit TV camera mounted in a shielded container for protection against radioactivity and other radiation.

be in the camera and monitor together, so that the picture remains steady.

Another simplification is the absence of the r.f. tuner and the i.f. section. Only the video signal is received and need be amplified. In instances where sound is transmitted, it takes the form of a regular office intercom.

The simplest system is not necessarily the one most frequently used. Several monitors may be used with one or several cameras as illustrated in the block diagram of Fig. 6. Also, the normally maximum distance of 500 feet between the camera and camera control may be extended by the addition of line amplifiers or even by the use of an r.f. carrier. Some of the industrial TV systems made by *RCA* and others actually use an r.f. carrier for the picture information. Even the use of a microwave link to transmit pictures between plants or branch offices is possible.

The circuits used in the camera and its associated networks deserve some elaboration. Fig. 5 shows the major components used with the vidicon camera tube. This tube is widely used in industrial TV cameras. As shown here, a long focusing coil is placed over the deflection yoke and there are two permanent magnet centering rings behind the focusing coil. Grid 4 is the high voltage element, and the actual video signal is derived from the photoconductive layer located inside the glass faceplate. Most cameras are designed to work with standard 16 millimeter motion picture lenses.

A typical camera section circuit is shown in Fig. 7. Note that the video amplifier and deflection circuits are quite simple when compared to the extensive networks used in TV studio cameras. One important simplification is the omission of a monitoring picture tube of the type normally found inside most studio cameras.

Some of the more elaborate closed-circuit TV systems use a special control unit which provides synchronizing pulses for vertical and horizontal sweeps. The frequencies are generally the same as for home receivers, *i.e.*, 60 cps and 15,750 cps, respectively. In some control units a higher frequency crystal oscillator and divider network is used, and in others the 60 cps power line frequency is used to lock in the vertical sweep and a frequency multiplier then "beats" this up to 15,750 cycles to synchronize the horizontal sweep. There are also some systems where the synchronization of the two sweep frequencies is less exact.

The basic industrial TV system described so far is suitable for indoor installation where not too many monitors are required and where only a fixed area is to be viewed. In actual practice, one of the features of TV is that it can be used anywhere, to see anything. For this reason many refinements and special features are available to adapt the basic closed-circuit TV system to any particular need.

Typical Installations

A good example of the special accessories used with industrial TV is shown in Fig. 11, which is a photograph of a weatherproof outdoor TV camera on location at a railroad loading platform. Windshield wipers are provided on the camera case and can be actuated from the monitor position should rain or snow obscure the view.

To look into a furnace requires special goggles and even then, the heat can be unbearable for the average human. But, as shown in Fig. 12, a camera can be provided with a smoked-glass lens and a special water cooling system to keep it cool. The operator, as shown, can accurately observe the action in the furnace, or even in several furnaces at the same time, without leaving his air-conditioned booth. The chance for fatigue, accidents, and heat prostration which is common in foundry work, is thereby reduced.

In addition to special camera cases and cooling systems, remotely controlled "panning," camera aiming, and lens switching are also available. This permits the operator at a guard booth, for example, to scan the guarded area at his discretion without leaving the monitor. Changing lenses remotely is especially useful in applications at atomic installations or other places where the human operator should be able to see both close and distant occurrences. It is a well known fact today that in most atomic labs and medical institutions dealing with radioactivity TV plays a most important part in daily operations. One of the sidelights in this connection reveals that cameras located in "hot" areas must be junked when defects occur in them. The cost of a camera, about $1000, may seem high, but in comparison with the cost of atomic instruments or even the operating costs of most installations, the amount spent for junked cameras is negligible. A

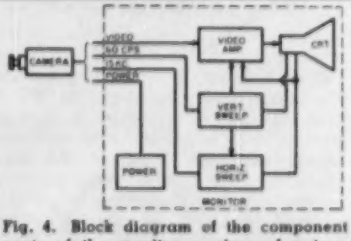


Fig. 4. Block diagram of the component parts of the monitor receiver of a two-unit closed-circuit television system.

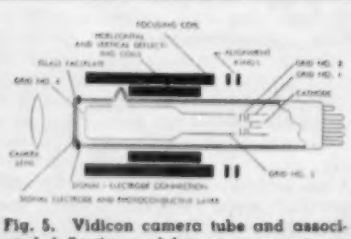
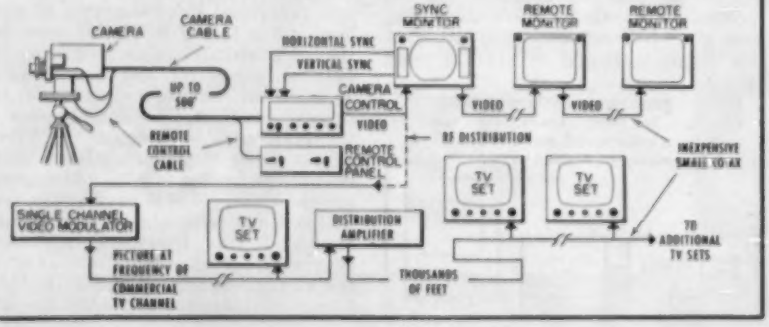


Fig. 5. Vidicon camera tube and associated deflection and focus components, as used in most industrial television units.

Fig. 6. A single camera may be used with any number of monitors and with long lengths of cable if sufficient distribution amplifiers are used as shown here.



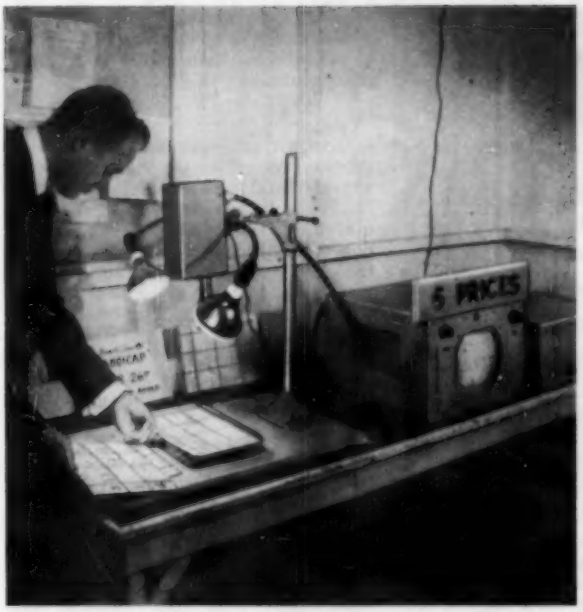


Fig. 8. The TV camera setup for the system shown in Fig. 9.

Fig. 9. Cashiers at the race track are advised of the price paid out on various horses, by means of closed-circuit TV.

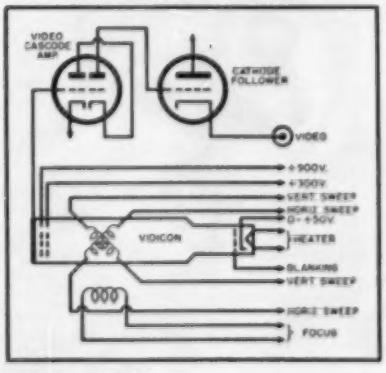
special camera used for radiological medical work is shown in Fig. 3, complete with shields and lenses.

More prosaic duties of industrial TV include remote indications of horse racing data (see Figs. 8 and 9), visual communications between laboratories and factories, and the use of TV for microscope pickup (as in Fig. 2). Following is a list of current operations controlled by closed-circuit TV installations furnished by one of the leading manufacturers in the field of industrial TV equipment. This list indicates how wide the field of closed-circuit TV is and, although lengthy, does not mention all of the possible uses of TV:

Tube cooling in a furnace
Bulk loading of scrap metal
Loading crushed limestone in storage bins
Sugar cane conveying
Combustion control, by smoke observation
Flight information display
Furnace interior viewing
Steel pouring
Centralized water level observation
Steel slab reheating furnace loading
Jet engine test stand observation
Plant protection (day and night)
Strip mining digging
Rotary cement kiln observation
Detecting shoplifters in stores
Remote x-ray study in hospitals
Atomic reactor work
Wind tunnel tests
Freight car identification
Facsimile transmission between plants (documents)
Parking lot supervision

This list is by no means complete, but will give the reader some idea of the future possibilities and the scope of industrial TV. In addition to these applications, closed-circuit TV is finding increasing use by the armed forces, police departments, and educational institutions.

Fig. 7. Shown here are the operating voltages required by the various elements of a vidicon tube and the typical video circuit used in the camera for industrial TV.

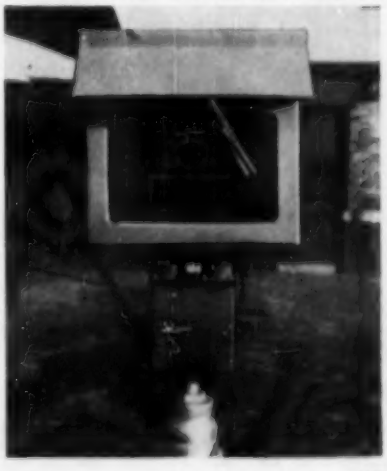


Some Economic Facts

The cost of the installation is often the deciding factor in whether closed-circuit TV will be used. The cost includes not only the cost of the equipment but also the cost of installing and servicing the system. The actual cost of the equipment will depend greatly on the application. For example, the *RCA* "TV Eye" camera and control unit lists at $995. This does not include the monitor, but any commercial TV set can be used, with an r.f. signal input on any TV channel. The camera control unit contains all sweep circuits and also provides modulation for any channel between 2 and 6. An

Fig. 10. The Farnsworth two-unit system.

Fig. 11. Closed-circuit TV camera mounted within a special weatherproof container, such as is used in a railroad switchyard.



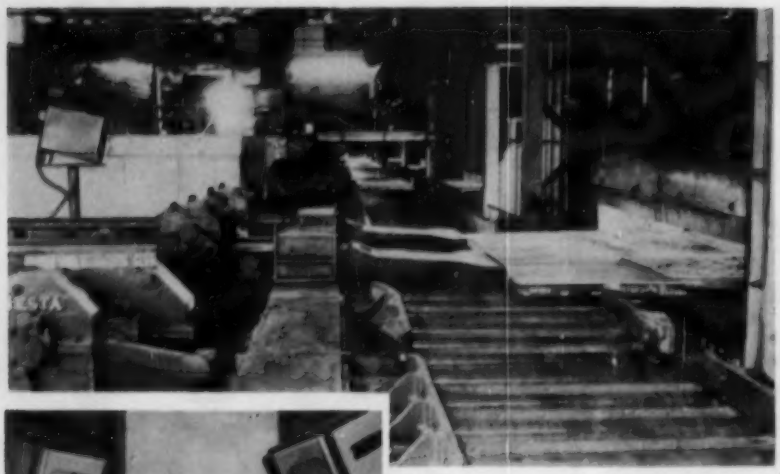


Fig. 12. A TV camera in a rolling mill observes the operation of a steel heating furnace. The camera is contained in a heat resistant box which is water cooled and incorporates a smoked-glass filter in front of the lens. The operator of the rolling mill is in an air-conditioned booth and performs the necessary steps by observing the pictures on the monitors.

f:4.5 lens and 20 feet of cable come with the equipment. The cable to the monitor from the control unit is not furnished and costs about 5¢ a foot. The monitor will cost $150 or more depending on what TV set is used. Thus, a very basic installation could be put together for about $1200 for equipment.

The cost of labor for the installation may vary from $100 to $1000 depending on the cable route, platforms, special lights, and other accessories which may be needed. Maintenance per year should be figured at about 20% of the equipment cost with the exception of the replacement of the camera tube. This tube, type 6198 vidicon, lists at $345.

Any special requirements such as a dustproof camera, weatherproof or watercooled camera housing, telephoto lens, remote controlled camera motion, several monitors from one camera or several cameras feeding a single monitor with a selector switch, etc., involves additional cost and the installation and servicing costs increase in proportion. In spite of this apparent high cost, the time saved, safety features, and flexibility of closed-circuit TV are so favorable that most progressive managements will gladly accept it.

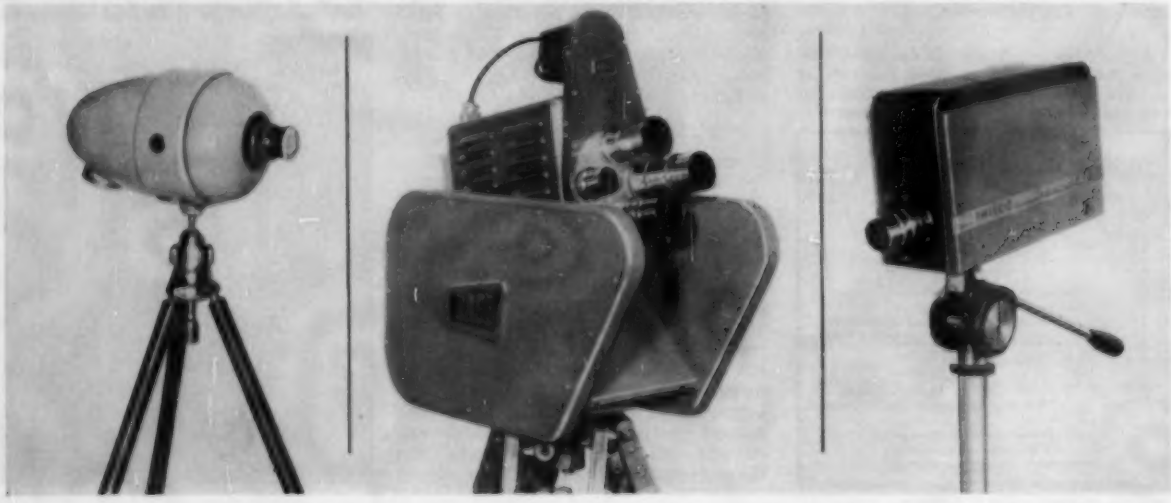
Servicing

Most manufacturers provide detailed service procedures for their equipment which should always be followed exactly. While in commercial TV it is permissible to substitute any kind of paper capacitor for a defective one, in industrial equipment the temperature rating as well as the voltage rating are quite important. Most of the maintenance and troubleshooting will be done on the owner's premises since the over-all operation can best be checked on location. This requires portable test instruments as well as a good stock of spare parts right in the truck.

In dismantling casings and removing shields and covers be absolutely sure that the gaskets, cushions, or other fittings are still good. When reassembling the equipment these items should be checked off carefully. Loosely fitting dustcovers, or missing weather-stripping may result in serious damage to equipment. Another item to look for is the air filter which is in the intake grating of forced-air cooling systems. Always make sure the filter is still good and not too full of dust. It is good practice to replace air filters regularly, the exact intervals depending on the installation, but never less than every 6 months. Cables and connectors which may be damaged should be replaced only by exact equivalents since otherwise impedance mismatch can result.

Some service technicians habitually screw the back on a TV set with three screws, even if the original set came with eight. To duplicate this careless practice in industrial TV would be an invitation to customer complaints. Expensive equipment should be treated with care and all service work should be done with quality in mind. —30—

Three different industrial TV cameras are shown here. The General Precision Laboratory camera on the left uses a "Staticon" tube, the Philco camera on the right uses a vidicon. The Dage camera is mounted in an automatic tilting and "panning" accessory.



A Transistorized Portable Phonograph

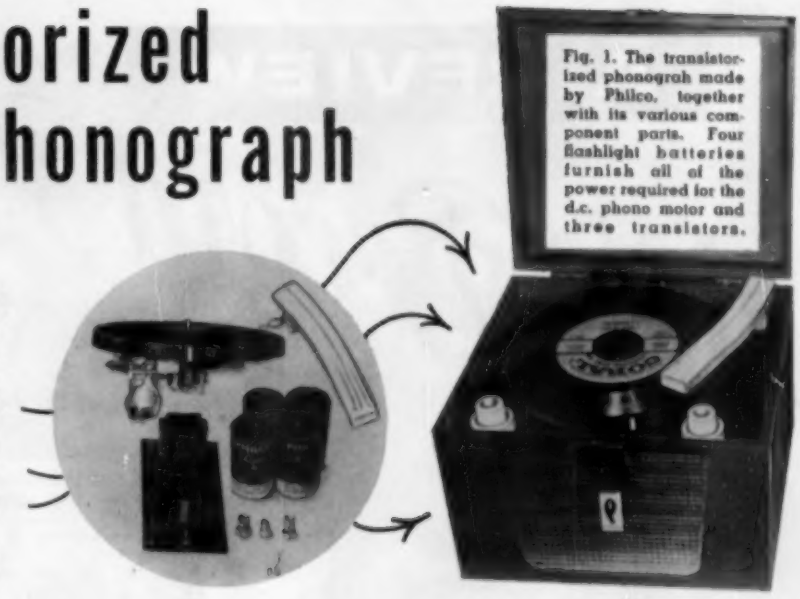


Fig. 1. The transistorized phonograph made by Philco, together with its various component parts. Four flashlight batteries furnish all of the power required for the d.c. phono motor and three transistors.

A new self-powered, completely transistorized portable phonograph for 45 rpm records only now made by Philco.

THE first completely transistorized portable phonograph, which plays 45 rpm records and operates from the power supplied by four 1½ volt dry cells, will be available from *Philco* soon. The new unit is shown in Fig. 1.

Three fused-junction transistors are used in a two-stage audio amplifier circuit. The phono motor is a special 4-volt type. The phonograph will play up to 3000 standard 45 rpm records before the batteries, which are standard flashlight cells, require changing. Because of the low power drain, 150 hours of continuous operation is possible with this phonograph.

The new set has the smallest turntable motor of any phonograph on the market. It is a 4-volt motor weighing less than 3 ounces and is approximately one-fifth the size of conventional motors. Power requirements for the motor are supplied by the four dry cells connected in series. Actual operation voltage for proper motor speed is between 3.5 and 4 volts, which is obtained through a "speed control" potentiometer. This control is also used to compensate for any loss of voltage as original batteries grow old. The motor itself is designed for 45 rpm record speed only, so that no complicated motor-to-turntable coupling system is necessary.

Among other features of this phonograph is the tone arm which serves as the "on-off" switch and automatically stops the turntable and turns off the set after each record is played, thereby helping to save the batteries. Of course, since transistors are used, no warm-up time is required. Records can be played with the lid closed.

Circuit

The transistor phonograph uses a printed-wiring chassis with a 4-inch speaker. The complete circuit is shown in Fig. 2, and consists of a transistor amplifier driver stage feeding two transistor stages in push-pull output. The transistors used are fused-junction types L5021 and L5022, manufactured by *Philco*. The fused junction transistors are capable of relatively large power amplification for transistors, which explains the fact that quite a bit of volume is obtainable from this phonograph despite the few stages.

The crystal pickup feeds a high-output signal to the volume control from where it is transformer-coupled to the base connection of the first amplifier stage. This transistor, as well as the others, is employed in a grounded-emitter circuit. The output from the L5021 transistor is then high-impedance transformer-coupled to the push-pull output stage.

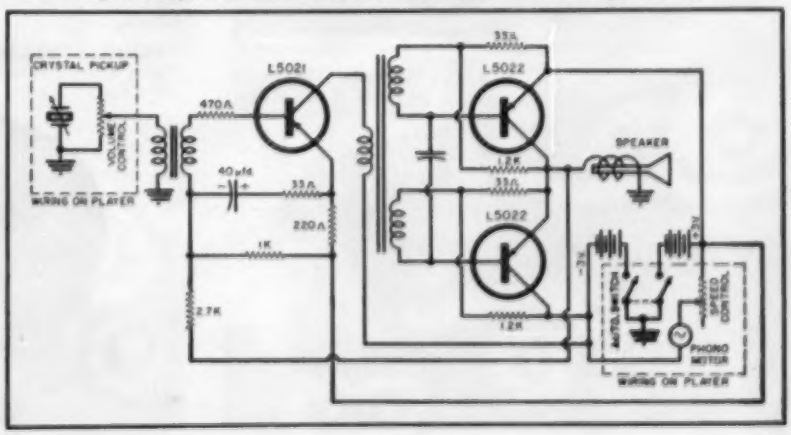
To obtain the required collector-base potential in the driver stage, the base is biased positively (as is also the emitter) by one battery while the collector is biased negatively by the other. A voltage divider consisting of the 1000 ohm and 2700 ohm resistors (and the speaker voice coil) supplies the proper bias to the base. The emitter is supplied through the 220 ohm resistor. The 2700 ohm resistor also furnishes feedback from the output stage to the input of the driver stage. The 40 μfd. capacitor in series with the 33 ohm resistor, from the emitter to the base of the first amplifier transistor, provides a low impedance path for the audio signal.

Since the output stage does not use complementary transistors, a two-winding secondary is used to supply signal to this stage rather than a center-tapped single winding. A capacitor provides coupling for a common base for the audio signal while isolating the two windings for d.c. biasing purposes. The output stage is low-impedance coupled to the voice coil of the speaker.

In servicing the amplifier, it is recommended that an oscilloscope be used in a conventional signal tracing procedure.

Two models of the transistorized phonograph are being made available by *Philco*, the TPA1 and TPA2. One is slightly larger than the other to permit the storing of thirty 45 rpm records in a special compartment in the cabinet. –30–

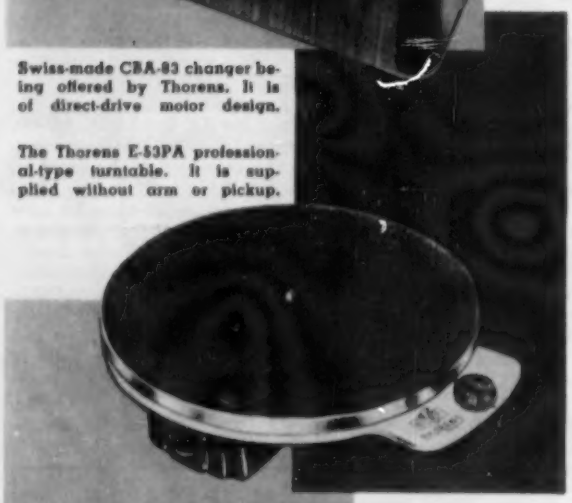
Fig. 2. Complete schematic diagram of the Philco transistorized phonograph.



A REVIEW of New Record Players

One of the basic units for any high-fidelity music system is, of course, the record player. Here are some of the more recent models.

Swiss-made CBA-83 changer being offered by Thorens. It is of direct-drive motor design.



The Thorens E-53PA professional-type turntable. It is supplied without arm or pickup.

The Model CD-43 record changer. It has a fine-tuning adjustment knob.

AMONG the new record-playing devices which have been released to the public in the past few months are those pictured and described here. Most of these new units offer interesting and unusual features which should be called to the attention of both the audiophile and the audio service technician.

Collaro Transcription Unit

A new British transcription turntable, the *Collaro* Model 2010, is being introduced to the American market by *Rockbar Corporation*.

Driven by a four-pole, dynamically-balanced, hum-shielded induction motor, the unit is designed to operate on all record speeds, 33⅓, 45, and 78 rpm. The motor is shock-mounted by means of lateral springs which effectively damp out mechanical vibration. The turntable itself is cast and machined (weighs approximately 8½ pounds) and is so formed that the greater part of its weight is in the rim for flywheel effect. The material is non-magnetic.

The turntable rotates on a 3½-inch long steel shaft which rides in a self-lubricating bearing. The vertical thrust is taken by a single steel ball. There is minimum frictional loss. The motor spindle is fitted with a 3-step pulley which couples to a single idler which, in turn, drives the inner rim of the turntable. Speed may be selected or changed at any time.

The turntable comes complete with a low-mass, non-resonant arm which houses the company's transcription pickup—a crystal cartridge with two mechanically isolated sapphire styli which are used turnover-wise for either standard or microgroove records. The nominal output of this cartridge is suitable for use with conventional preamplifiers.

The Presto "Pirouette" three-speed turntable. It is available with a four-pole induction or a hysteresis synchronous motor.

Two of the new V-M Corporation models. The Model 1250 is shown above and the Model 1200 at the right. Both units feature four speeds (33, 45, 78, and 16 "talking book" speeds). The three standard speeds are automatic, the 16 rpm is obtained manually.

The Model 2010 will accommodate all discs up to 16" and the pickup arm is designed to give good tracking on all sizes. The price, complete with cartridge and pickup arm, has been tentatively set at $72.00 (east of the Rockies).

Also of interest is the fact that the *Collaro* Model RC54 changer, which has been on the market since late last year, is now being supplied with a pre-cut mounting board and with a power cord and amplifier connecting cables attached, at no increase in cost.

Component Corporation Console Turntable

Component Corporation is marketing a transcription console version of its belt-driven "Professional" turntable as the Model 70.

A double shock-mounted, continuous-duty, constant-speed induction motor turns a three-step motor pulley, accurately machined, in its own bearings. An endless belt couples the proper pulley to the turntable's outer rim to drive it at 33⅓, 45, or 78.26 rpm. An expanding collet spindle accurately centers discs with oversize center holes.

The Model 70 has what is said to be the industry's heaviest turntable (25 pounds machined cast steel) which reduces rumble to —70 db, wow and flutter to .05% and speed variation to .25%.

Completely free from metal-to-metal contact, the turntable runs in a nylon sleeve and on a single ball-thrust bearing. Tempered steel, felt-damped springs provide over-all shock mounting and the console may be accurately leveled by rotation of these springs.

A thick cork cushion on the turntable protects record surfaces. Instantaneous cueing is provided by slipping the record (the turntable accommodates 16" transcriptions and 17¼" masters). There is ample room for mounting two or more arms on the console surface and accessory space at the rear of the console for mounting standard 19⅛" rack panels up to 22" high. The console is priced at $295.00, FOB, Denville, N. J.

Ercona Intermix Changer

The Electronic Division of *Ercona Corp.* has a new automatic record changer which will handle 12", 10", and 7" discs intermixed without wow, hum, or rumble.

The "Dekamix" will operate at all three speeds. It has a single-phase, four-pole asynchronous motor with auxiliary phase displaced by a capacitor. Operated at 110-125 volts, 60 cycles, a.c., power consumption is 10 watts. This same unit is also available for d.c. and 6 volt operation on special order.

The crystal cartridge that comes with the changer is of the turnover type and has two sapphire needles. The plug-in head will accept standard magnetic cartridges. A special

(*Continued on page* 180)

Ercona Corp.'s "Dekamix" intermixing record changer. It will handle 33, 45, and 78 rpm, 12", 10", and 7" discs intermixed.

The Collaro Model 2010, three-speed turntable. It features a four-pole, dynamically-balanced, hum-shielded induction motor.

The German-built "Rex AA" record changer being distributed by Fenton. It will intermix any size records between 6" and 12".

High

Even a Cadillac requires repairs and occasional adjustments—here are a few tips on troubleshooting your hi-fi sound system.

BUYING high-fidelity equipment is like getting into the *Cadillac* class. One pays more for superior design, components, and performance. Yet it stands to reason that a *Cadillac* limping along on four cylinders is less satisfactory than an inexpensive car purring along on eight. Similarly a high-fidelity system that falls measurably short of specifications gives less listening pleasure than the run-of-the-mill radio-phono combination.

The purchaser of high-fidelity equipment faces two problems: (1) getting it to work at 100% of potential; (2) keeping it that way. New or old, the system is subject to infiltration by an assortment of "bugs." Among the factors responsible are: mismatching of components, use, age, accident, climatic conditions, and perversity of inanimate objects.

The more expensive the system, the more agonizing the bugs are apt to be, both from the psychological viewpoint and the musical aspect. As an initial precaution, the audiophile should purchase components from a reliable organization that backs up its merchandise with a satisfactory repair or exchange policy. If feasible, it is wise to assemble the selected components at the dealer's place so that the system as a whole, or a substantial part of it, can be checked for satisfactory sound and operation. In addition, it is worthwhile to have each piece of equipment checked by a technician with the proper test instruments; flaws may thus be revealed that are otherwise not immediately apparent.

Once in use, the system should be checked periodically, as one does a car or expensive camera.

This article lists some of the more common "bugs" found in hi-fi systems. Various difficulties, such as tuner misalignment, require the services of a technician. Others, such as an incorrectly seated stylus, can often be remedied by the non-technical user.

Phonographs

1. *Inaccurate speed.* A stroboscope card, readily obtainable for a few cents or even free at most radio supply houses, indicates speed accuracy when placed on a rotating turntable and observed under an electric light, preferably fluorescent. The bars (or dots) on the card appear stationary if speed is exact. They appear to move clockwise if speed is fast and counterclockwise if slow. By counting the number of bars that appear to move past any given point within one minute, it can be determined whether the speed is within a satisfactory range of error. Professional standards call for a maximum deviation of .3% above or below specified speed, which translates into a movement of 21 bars-per-minute, clockwise or counterclockwise, for any of the three speeds in common use. For ears not overly sensitive to pitch, however, deviations as large as one, two, or even three per-cent (movement of 72, 144, or 216 bars-per-minute) may be tolerated. Speed inaccuracy greater than 3% is unacceptable.

2. *Inconstant speed (wow).* Constancy of speed is even more important than accuracy because of the ear's sensitivity to sudden changes in pitch. Appreciable wow can be observed visually by watching the stroboscope card for sudden brief fluctuations in speed. An aural test may be made by listening to a frequency test record (sold by many radio supply houses) or to music containing single tones, for example piano compositions. Wow may be caused by such factors as dirt on the inside rim of the turntable, slick idler or drive wheels, and an off-center turntable. Cleaning the phonograph parts with detergent *recommended by the phonograph manufacturer* may alleviate the trouble. In the case of slick wheels, however, replacement is usually the best course, although sometimes a slight sanding may turn out well.

3. *Hum.* Hum can often be reduced simply by a 180-degree turn of the 117 volt a.c. power plug of the phonograph or amplifier. Magnetic pickups are sensitive to hum fields such as those generated by the phonograph motor. This hum field may be transmitted by the turntable. Placing a rubber mat on the turntable to effect greater separation between it and the pickup may reduce hum. The phonograph chassis should have an excellent ground connection to the chassis of the amplifier or preamplifier. Although the shield of the phonograph lead to the amplifier supplies a ground, a better one can often be effected by connecting a heavy wire between the two chassis; sometimes different grounding points on the phonograph chassis will produce varying results.

4. *Clicks.* Loud clicks or pops may be heard when the phonograph is turned on or off. These can be substantially eliminated by wiring a .5 μfd., 600-volt capacitor between the two leads to the phonograph motor.

-Fidelity Bugs

By **BURT HINES**

5. *Stylus distortion.* Distortion may be due to a stylus that is incorrectly seated. Viewed head on, the stylus should appear to ride perpendicular to the record surface, not inclined to the left or right. In the case of magnetic pickups it is important that the stylus be well centered between the pole pieces on either side of it. A stylus touching or almost touching a pole piece will distort. Similarly, dirt lodged between the stylus and either pole piece restricts stylus movement and causes distortion. It should further be borne in mind that distortion may be due to a worn stylus, particularly if it has a sapphire rather than diamond point. A sapphire's life is on the order of 25 hours, while a diamond is good for hundreds and even thousands of hours.

6 *Incorrect load resistors.* For each brand of phonograph pickup there is an optimum load resistance which gives smoothest and widest range reproduction. The correct value is available from the manufacturer. Some preamplifiers have a variable load resistor, while others have a fixed resistor which either matches one specific pickup or else has a value based on the average load resistance for several popular pickups. The best possible performance can be obtained from a pickup only by making certain that it feeds into the load resistance specified by the manufacturer.

7. *Absence of high frequency cut.* Because of treble emphasis on records, the output of a magnetic pickup requires a substantial amount of treble cut in order to achieve flat response. Some amplifiers do not provide this treble cut except through the treble control. However, a more satisfactory procedure when using such an amplifier is to obtain treble de-emphasis by wiring a resistor of the proper value between the terminals of the magnetic pickup. The value of this resistor, which can usually be obtained from the pickup manufacturer, depends on the characteristics of the pickup and the amount of treble cut required. For example, using a *G-E* pickup, equalization of the standard RIAA curve, as far as the high end is concerned, requires a resistor of about 7500 ohms. To achieve correct high-frequency equalization of other recording characteristics, which in the main differ but slightly from the RIAA curve at the high end, the treble control can be used to effect the necessary adjustments. However, it is not a good idea to use the treble control for all the treble cut required by the RIAA curve or any other curve because there is a tendency on the part of many listeners to leave the treble control in flat position.

Tuner Troubles

1. *Incorrect alignment.* Perfect alignment is far more essential to FM tuners than AM tuners. Inadequate alignment of an FM tuner results not only in loss of sensitivity but, much worse, in distortion. An FM tuner that once operated correctly may drift out of alignment with age. In any event, an FM tuner can often profit from a check by a technician with the instruments, skill, and disposition for precise alignment. Stay away from the man who aligns by ear.

2. *Incorrect treble de-emphasis.* FCC regulations require that FM stations apply a prescribed amount of treble boost, technically known as "75 microsecond pre-emphasis," to their signals. FM tuners should therefore have a corresponding amount of treble cut in order to achieve flat response. However, some tuners have substantially less than the required amount of cut, the net result being that the tuner sounds shrill by comparison with the same music on a record. Insufficient treble cut may be deliberate on the part of the manufacturer—perhaps out of a desire to impress the user with the highs of his tuner—or it may be accidental as the result of components with incorrect values. Occasionally a tuner may have too much de-emphasis and therefore sound "bass-y." It takes only a few minutes for a technician to check the de-emphasis network of an FM tuner and, if change is needed, to replace one resistor costing a few cents. On the other hand, if an unusually long cable is required between the FM tuner and the amplifier, which may result in attenuation of high frequencies, it may be advisable to compensate the loss of highs by using a de-emphasis network with a value less than 75 microseconds.

Amplifiers and Preamps

1. *Incorrect alignment and/or operation.* Many commercial amplifiers, probably the majority, require no alignment or at least do not provide a means for it. Some, however, especially those using the popular Williamson circuit and variations of it, require balancing and adjustment of the currents in the output tubes which supply power to drive the speaker. When output tubes are replaced, realignment is necessary. This is usually a job for the technician, except in the case of some amplifiers which incorporate a means for the owner to perform the alignment. If the audiophile wishes to make certain that his amplifier meets the manufacturer's specifications, he will have a technician check power output, distortion at various power levels, input connections, output connections, range and flat setting of tone controls, selector switch operation, and other features that the amplifier or preamplifier may boast.

2. *Excessive amplifier gain.* This is a problem most often encountered when a preamplifier (including tone controls, sharp cut-off filters, etc.) is purchased separately from the basic power amplifier. However, it sometimes occurs in a single chassis unit which contains not only the power amplifier but also the same controls as a separate preamplifier. The power amplifier produces amplification not only of desired signals but also of hum and noise in the preamplifier. Although a low setting of the volume control in the preamplifier reduces hum and noise in stages preceding the control, hum and noise in succeeding stages of the preamplifier usually remain the same. An exception occurs in some preamplifiers which have dual volume controls ganged for operation by a single knob; one control is at an early stage and one is at the final stage or output of the preamplifier. Except when dual volume controls are used, it may be necessary to reduce gain of the basic amplifier to a "practical" level in order to cut down preamplifier noise and hum. This "practical level" is one which at maximum position of the preamplifier volume control provides the user with the most volume he ever intends to use and no more. Some basic amplifiers contain a variable input control for this purpose. If not, it is a simple matter for a technician to install one. Besides keeping hum and noise down, reduction of the power amplifier's gain prevents possible damage to amplifier components of speakers through accidental generation of excessive audio power.

On the other hand, it is possible to

cut amplifier gain excessively. Therefore, if the preamplifier has to deliver increased voltage in order to drive the power amplifier to desired output, the increased voltage will contain more distortion. Thus it may be necessary to accept a slight amount of noise and hum—discernible only within a few inches of the speaker—in order to keep preamplifier voltage and distortion down. However, if the preamplifier has a dual volume control such as previously described, this compromise is less or altogether unnecessary.

3. *Incorrect gain setting of sources feeding the amplifier.* Most tuners, tape recorders, etc. have volume controls, especially if they are capable of generating in excess of 2 volts maximum audio signal. If the tuner, etc. output voltage is too low, the amount of tuner signal may not be sufficiently high compared to hum and noise in the preamplifier and amplifier so as to keep the latter sounds inaudible. On the other hand, if the tuner output is too high, there may be danger of overloading the first stage of the preamplifier unit and causing distortion. For best results, therefore, the volume control of the tuner should be set to deliver just enough signal to drive the amplifier to the desired level. Generally such a signal will range between .5 and 2 volts maximum. Some preamplifiers have input level controls for adjusting the gain of input signals. In this case the tuner volume control may be left full on and the preamplifier input level control adjusted instead.

4. *Motorboating.* This can sometimes be identified by a "putt-putt" sound from the speaker, but not always, because motorboating can also take place at a sub-audible frequency. Audible or inaudible, motorboating can produce distortion, not only in the amplifier but also in the speaker due to excessive cone travel. Motorboating frequently occurs, for example, when an attempt is made to supply both a preamplifier and a power amplifier from the same source of high voltage current. Ordinarily the cure consists of better decoupling between the high voltage supply to the power amplifier and the supply to earlier audio stages.

5. *Inadequate grounding.* If there is objectionable hum it may occasionally be due to inadequate ground connections between the amplifier or preamplifier chassis and the various other chassis. This problem has already been discussed in connection with the phonograph under point 3 of that section. In some cases hum can be reduced by running a heavy wire from the amplifier chassis to a metallic earth ground, such as a water pipe or radiator (never a gas line).

6. *High frequency losses due to cable capacitance.* The shielded cables that connect components such as a tuner or phonograph to the amplifier or preamplifier may have enough capacitance to act as a partial short circuit at high frequencies. The degree of short circuiting in a cable more than three or four feet long can be serious at high frequencies unless the source feeding the amplifier has low impedance. Therefore, unless manufacturer's instructions indicate otherwise, shielded cables should be as short as possible and have as low a capacitance per foot as is commercially available—about 25 $\mu\mu$fd. per foot. Today many tuners, preamplifiers, tape recorders, etc. provide low impedance cathode-follower output, which enables a cable of substantial length to be used without high-frequency losses.

Speaker Faults

1. *Incorrect port size of bass reflex cabinets.* As a minimum precaution, speaker manufacturers' recommendations should be observed in determining the size of the port in a bass reflex cabinet. Use of a ready-made cabinet with a port of fixed size will produce varying results with different speakers; therefore an adjustable port is advisable. Many persons are willing to trust their ears as to what size port produces the smoothest and fullest bass response. Those who wish to be on technically safe ground can call in a technician equipped with the instruments necessary to determine optimum port size.

2. *Woofer-tweeter unbalance.* Frequently the components of a two-way speaker system are not balanced for equal output, resulting in heavy or shrill sound, depending on whether the woofer or tweeter is operating at the higher level. With care, proper balance can be achieved by ear. However, to achieve balance with technical accuracy requires the use of a frequency record or audio oscillator to feed, alternately to each speaker, several tones in the area of the crossover frequency, that is, in the area where both speakers can be expected to operate efficiently. These tones should be fed directly from amplifier to speaker, bypassing the crossover network that separates high and low frequencies and feeds them to tweeter and woofer respectively. The more efficient speaker, usually the tweeter, is reduced to the level of the other speaker by means of an attenuating device such as an L-pad. In the case of a three-way system, woofer and mid-range speaker may first be balanced against each other, and then the tweeter may be balanced against the mid-range speaker. A similar procedure would be followed for a four-way system. Once the attenuating devices for each speaker are set, they should thereafter be left undisturbed except in such cases as replacement of speakers or movement of the speaker system to another location.

3. *Crossover "holes."* If the components of a crossover network differ significantly from design values, it is possible for the response of the speaker system to drop substantially in the region of the crossover frequency. That is, the combined output of the tweeter and woofer in the area of the crossover frequency may be substantially less than the system's output at other frequencies. Conversely, it is possible for a peak, although a moderate one, to appear in the crossover area due to faulty crossover values. If the owner suspects a "hole" in his system it may be wise to have the crossover network checked by a technician both with respect to values of components and actual performance. This is especially advisable in the case of home-built crossovers.

4. *Incorrect speaker phasing.* If two speakers in adjoining frequency ranges of a multiple speaker system are oppositely phased, that is, if the voice coil of one moves in while the other moves out, there may be considerable attenuation of frequencies in the neighborhood of the crossover frequency because sound waves of opposite phase tend to cancel. Frequency cancellation is most noticeable for single tones. Therefore single tones such as produced by a frequency test record or audio oscillator are suitable for obtaining correct phasing of speakers. The procedure is to reverse the leads to one of the two speakers and to select the position of the leads which results in the loudest combined sound from the two speakers for a frequency in the crossover range.

5. *Incorrect impedance matching.* When one speaker or speaker system is used, it is simple enough to connect the speaker to a terminal on the amplifier which is rated at the same impedance as that of the speaker. However, when several speakers are used in various parts of a home, all operating off one amplifier, their combined impedance differs from that of any one speaker. Consequently the impedance of the speakers as a group no longer matches that of the amplifier and there is a loss in the amount of power transferred from the amplifier to the speakers. To obtain the amount of power needed by the speakers it is necessary to operate the amplifier at a higher output, which means more distortion. Where multiple speaker installations are used, it is necessary to determine which output terminal on the amplifier will best match the collective impedance of a group of speakers. —30—

TAPE RECORDING

The Tape

By **HERMAN BURSTEIN**

Part 2. Magnetic tape in all its phases. Such characteristics as bias voltage, distortion, record level, magnetic properties, and frequency response are all important factors in obtaining high-fidelity performance from your sound system.

LAST month, in Part 1 of this current series, we discussed the essential elements of tape recorders and covered, in some detail, the transport mechanism, the record-playback and erase heads, and the bias oscillator.

Now we will turn our attention to the recording medium—in other words—the magnetic tape on which the program material is captured.

The Tape: Tape consists of a coating of magnetic material on paper or plastic base, usually the latter. The coating is a special ferrous oxide of extremely fine particle size, which is mixed with synthetic resins to bind the oxide to the base. Standard tape is ¼" wide and .0021" thick; the coating is about .0006" and the base .0015". Of quite recent date is the so-called long playing tape, which is two-thirds as thick as standard tape and therefore offers 50 per-cent more playing time on a given size reel.

A 7" diameter reel is accommodated by most home machines. It holds 1200 feet of standard tape or 1800 feet of long playing tape. At 7.5 ips this offers 32 or 48 minutes of playing time. A 7.5 ips machine with half-track heads can therefore record 64 or 96 minutes of material on a 7" reel. A 10½" reel holding 2400 feet of standard tape is often employed on professional machines. Reel sizes greater than 10½" are sometimes used on professional recorders, while reels smaller than 7" are available for all recorders.

Important mechanical characteristics of tape are strength, smoothness, and limpness. A breaking strength of four to five pounds is required to enable tape to withstand the strains of sudden starts and stops and fast wind and rewind. Tape must be smooth to insure both minimum head wear and good contact with the heads. Vibration due to roughness produces noise. Therefore tape generally contains a minute amount of lubricant. Limpness enables the tape to hug the heads and make sharp turns around guides, tensioning devices, etc.

The magnetic coating contains a host of magnetic "domains," each a group of atoms with a common physical characteristic such that the domain is, in effect, a minute magnet. In an unused or demagnetized tape the domains point in random directions. Therefore the tape has no magnetic pattern except that corresponding to the random orientation of domains, which produces tape "hiss."

Under the influence of the record head's magnetic field, produced by audio current, the domains are forced to align themselves in accordance with the polarity of the field as the tape moves past the gap. In short, the tape is magnetized. The number of domains aligned in a given direction at any instant varies with the level of audio current. However, if the current is great enough, all the domains become aligned, representing tape saturation. Additional current produces no further magnetization of the tape.

(*Continued on page* 127)

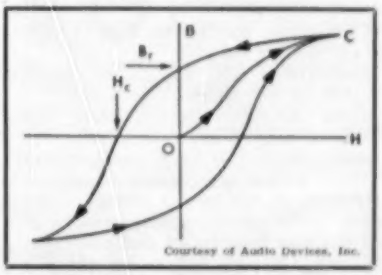


Fig. 1. Variation of magnetic induction (B) with magnetizing force (H). Refer to article.

Recording and playing times of various lengths of standard and "Extra-Play" recording tapes. Courtesy of Minnesota Mining & Manufacturing Company.

REEL SIZE (in.)	TAPE LGTH. (feet)	UNINTERRUPTED RECORDING TIME* FOR VARIOUS TAPE SPEEDS AND TAPE LENGTHS (TAPE SPEED—inches per second)						DUAL TRACK TIME	
		15/16 ips	1⅞ ips	3¾ ips	7½ ips	15 ips	30 ips	3¾ ips	7½ ips
3	150	½ hour	15 min.	7½ min.	3¾ min.	.....	.....	15 min.	7½ min.
4	300	1 hour	30 min.	15 min.	7½ min.	3¾ min.	1⅞ min.	30 min.	15 min.
5	600	2 hours	1 hour	30 min.	15 min.	7½ min.	3¾ min.	1 hour	30 min.
5	900**	3 hours	90 min.	45 min.	22½ min.	11¼ min.	5⅝ min.	90 min.	45 min.
7	1200	4 hours	2 hours	1 hour	30 min.	15 min.	7½ min.	2 hours	1 hour
7	1800**	6 hours	3 hours	90 min.	45 min.	22½ min.	11¼ min.	3 hours	1½ hrs.
10½	2400	8 hours	4 hours	2 hours	1 hour	30 min.	15 min.	4 hours	2 hours
10½	3600**	12 hours	6 hours	3 hours	90 min.	45 min.	22½ min.	6 hours	3 hours
14	4800	16 hours	8 hours	4 hours	2 hours	1 hour	30 min.	.....	.....
14	7200**	24 hours	12 hours	6 hours	3 hours	90 min.	45 min.	.....	.....

* Single track only. For dual track recording, double the time.
**"Scotch" brand "Extra-Play" magnetic tape No. 190.

Broadcast-Band Test Oscillator Using Transistors

By **LAWRENCE FLEMING**
Chief Engineer
Electronic Engineering & Service Co., Inc.

Fig. 1. Front panel of the complete signal generator for the broadcast band that uses transistors and batteries. The instrument is 5" long, 4" high, and 3" deep.

An accurate, stable, and extremely portable battery operated test instrument for radio and p.a. servicing.

RECENT improvements in and price reductions of transistors have made a lot of new applications practicable. One is described here. This instrument furnishes test signals for broadcast receiver and p.a. servicing, as follows:

R.f. voltage: variable up to 25 millivolts.

R.f. tuning: continuous, 550 to 1700 kc. and 400-500 kc.

Modulation: AM, approximately 30 per-cent at 700 cycles.

Audio output: approximately 700 cycles, variable 0-250 millivolts.

Incidental FM is very small, owing to the use of a low-impedance crystal modulator in the output circuit. The entire "tube complement" consists of two junction transistors and one crystal diode. Over-all dimensions are 3" x 4" x 5".

Directly below the tuning dial on the panel (see Fig. 1) is the "Hi-Lo" switch for changing frequency bands. The knob at the right on the instrument panel goes to the output voltage control, a 500-ohm potentiometer. The phonograph-type jack in the lower right-hand corner takes a length of crystal microphone cable for the output. The "R.F.-Audio" switch transfers the output from the r.f. oscillator to the internal 700-cycle audio oscillator. The output control pot is operative in either position of the switch. Alongside the power "On" switch, the "Mod.-C.W." switch simply turns the internal audio oscillator on or off, leaving the r.f. circuit undisturbed, and the r.f. level unchanged.

The r.f. output voltage is amazingly constant over the tuning range for a device of this type, staying within 2 db from 550 kc. to 1700 kc. The output impedance is low enough so that a 3-foot crystal microphone cable does not affect the output at either end of the tuning range. The frequencies are too low to require impedance matching at the ends of the cable.

All the components are mounted in a *Bud* CU-2105 "Minibox." The coil and the small output transformer (which serves as the audio oscillator inductance) are mounted on the left-hand side of the cabinet, as shown in Figs. 3 and 4, and the remaining parts on the front panel. The transistors and a few odd resistors and capacitors are soldered to an eyelet lug strip retrieved from the junk box. The strip measures about ¾" x 3" and is mounted on a pair of 1½" stand-offs. As far as electrical performance goes, nothing fussy was found about the parts placement or lead dress.

The batteries do not show in the photographs. They are mounted on the inside of the box cover, and occupy the empty space to the right of the tuning capacitor and the transistor strip, visible in Fig. 3.

The basic limitation in size reduction of test instruments lies in the requirements of the user's hand and eye. Knobs must be large enough and adequately spaced for easy operation. Dial and meter scales must be large enough to read without squinting. These needs, in some cases, lead to a minimum panel size no smaller than is now usual. In many other cases, the instrument can be miniaturized without loss of utility.

In the instrument shown here, the only compromise with convenience is the rather small tuning dial, 2¾ inches in diameter. Four or five inches would be better, but it was possible to get all the other parts in and on the small box without squeezing, and without loss in accessibility.

Circuit

The circuit of the test oscillator in Fig. 2, uses two junction transistors. The r.f. oscillator, V_1, is a *Texas Instruments* type TI 228, the audio oscillator, V_2, a type TI 200 of the same make. At the time of writing, the TI 228 was $4.00 and the TI 200, $3.00. (*Editor's Note:* Although these transistors are not regularly stocked by electronic parts distributors, they may be ordered from the manufacturer direct or through a distributor.) Type 228 is rated for oscillator-mixer service in broadcast receivers, and the type 200 for general purpose low-level audio work. Both are *n-p-n* transistors rather than the more common *p-n-p* variety. This means that the emitter is run negative and the collector positive, rather like a vacuum tube.

The r.f. oscillator is a Hartley-type circuit. Because of the taps required, the coil was home-wound. It is an old fashioned single-layer solenoid, close-wound with No. 32 "Formvar" wire on a 2-inch length of 1-inch diameter phenolic tubing. The "Q" of the coil measured over 100 all the way from 500 to 1800 kc., somewhat better than a lot of small universal-wound coils.

Tapping points are given in the parts list. The 4-turn secondary is wound over a piece of insulating tape at the "cold" end of the coil. The emitter is tapped 10 turns up from the "cold" end, through a .003 μfd. capacitor C_5. Emitter bias is supplied through the 3900 ohm resistor, R_3. Capacitor C_5 is an r.f. bypass across the collector battery. It is necessary for proper oscillation, but its value is not critical.

The taps on the oscillator coil L_1 are not particularly critical, but taps in general are among the most important parameters for experimentation in circuits of this type. Connecting the collector directly to the top end of the tuned circuit will, as is explained below, limit the maximum frequency of oscillation. But this is due to the transistor capacitance, not to any lack of gain in the loop. Oscillation is vigorous in either case. In fact, a couple of TI 202 transistors, which are rated only for audio use, were tried in place of the TI 228, and appeared to work just as well. The manufacturer's ratings must be followed, of course; a trial of two samples does not mean that every type 202 will work this way.

The 365 μμfd. tuning capacitor, C_6, easily covers the 550-1700 kc. tuning range, with 100 kc. or so to spare at the high end. The low band, for i.f. alignment, is obtained simply by switching a 400-μμfd. mica capacitor C_7, across the tuning capacitor, C_6.

The principal purpose of tapping the collector down on the coil instead of connecting it directly to the "hot" end, is to reduce the capacitive shunting of the tuned circuit. With the collector connected to the top of the coil, maximum oscillator frequency is only 1500 kc. at the minimum setting of the tuning capacitor. The tap also improves the waveform slightly and reduces the effect of battery voltage on oscillator frequency.

The audio oscillator operates in a transistor version of the Colpitts circuit. Main reason for this is that it is easy to change the position of the "tap" by changing capacitors. Digging into an audio winding is almost as discouraging as trying to wind one. The correct position of the "tap" with transistor oscillators is very low down on the tuned circuit, so that the shunting effect of the emitter bias resistor R_3 is very small.

The audio oscillator coil is a low-priced stock output transformer. About 0.25 volt is developed across the full voice-coil winding, which is about right for the crystal modulator. Audio waveform is fairly decent, as shown in the oscilloscope photograph, Fig. 7C. A special inductor could give a much better waveform, with as low as 0.5 percent distortion. It does not seem worth the expense, however, in view of the unavoidable distortion inherent in the modulation process (Fig. 7A).

Efforts were made at first to use "grid" or "plate" modulation on the r.f. oscillator. Application of audio signal either to the low side of the emitter bias resistor R_3, or to the collector through the low side of coil L_1 was, however, unsatisfactory. Incidental frequency modulation was excessive—as much as 50 kc.—and supply voltages and feedback ratio had to be adjusted rather critically in order to get a decent-looking modulation envelope.

It seemed undesirable to try designing an untuned r.f. amplifier into a device such as this one, which is intended to be simple as well as small. The answer was found in the low-impedance crystal modulator, as used by *General Radio* in special attachments for its standard signal generators.

The simplest form of crystal modulator involves merely a crystal diode in series with the low-impedance output line of the signal generator. The crystal is biased in the forward direction, so that it is conducting all the

R_1—300 ohm volume control, carbon type
R_2, R_4—15,000 ohm, ½ w. res.
R_3—3900 ohm, ½ w. res.
R_5—6800 ohm, ½ w. res.
C_1—200 μμfd. ceramic capacitor
C_2—400 μμfd. mica capacitor
C_3—365 μμfd. tuning capacitor (Philmore 1945 Q or equiv.)
C_4—.003 μfd. paper capacitor
C_5—.03 μfd. paper capacitor
C_6—.01 μfd. paper capacitor
C_7—.3 μfd. paper capacitor
CR_1—Type 1N34 germanium crystal diode
B_1—15 v. transistor battery
B_2—1.3 v. penlite cell
J_1—Phono-type jack or coaxial jack
L_1—Primary, 115 t. #32 "Formvar" wire, close-wound, single-layer on 1-inch diameter form, tapped at 10 t. and 70 t. Secondary, 4 t.
S_1—S.p.d.t. slide or toggle switch
S_2, S_3—S.p.s.t. slide or toggle switch
S_4—D.p.s.t. toggle switch
T_1—Output trans. 4000-14,000 ohms to v.c. (Stancor A-3856 or equiv.)
V_1—Type TI 228 transistor (Texas Instruments)
V_2—Type TI 200 transistor (Texas Instruments)

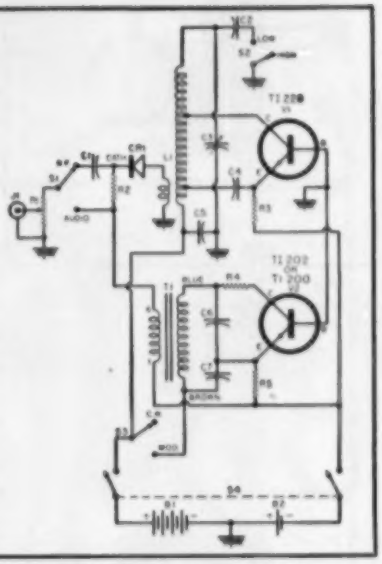


Fig. 2. Complete schematic diagram and parts list for the transistorized broadcast-band test oscillator. Modulated and c.w. outputs are available.

Fig. 3. Side view of the instrument showing the r.f. oscillator tuning capacitor. Space at right is for batteries.

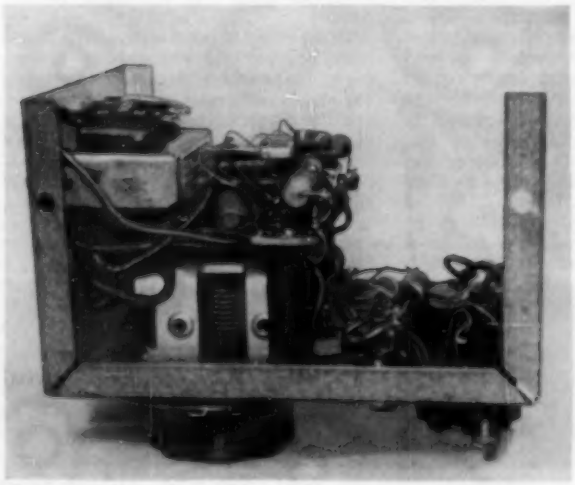
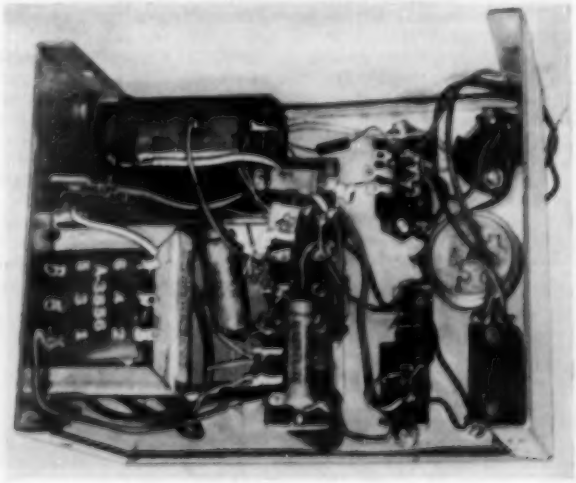


Fig. 4. Bottom view of the transistorized test oscillator showing the r.f. oscillator coil and audio transformer.



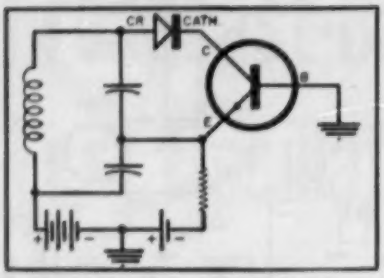


Fig. 5. Transistor oscillator with a crystal diode in the collector circuit to suppress reverse collector current.

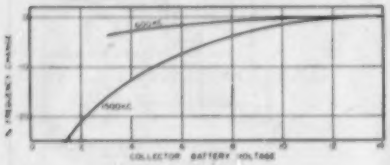


Fig. 6. Variation in r.f. oscillator frequency with collector bias voltage.

time. The amount of this forward bias is varied at an audio rate, varying the effective series resistance of the crystal.

In the circuit of Fig. 2, the crystal diode, CR_2, is in series, for r.f., with the 500 ohm output control R_1 as well as the output coupling coil on L_2. The 200 μfd. capacitor C_1 presents a fairly low impedance to the r.f. compared to the 500 ohm resistance of R_1, but effectively filters out the audio voltage from the output. The forward bias for the diode CR_2 comes from the emitter bias battery B_2, to which the secondary of the output transformer T_2 is returned. The 15,000 ohm value of resistor R_3 was selected to give the best-looking shape to the modulated wave on a scope, together with a not-excessive loss of r.f. voltage. More elaborate arrangements involving r.f. chokes and bypassed resistance networks were tried in place of the single resistor without any clear advantage.

Switch S_1 changes the output signal from r.f. to audio. In the "Audio" position of the switch, the r.f. oscillator is still operating, but there is no noticeable leak-through of r.f. to contaminate the 700-cycle output.

The change from c.w. to modulated r.f. is made simply by closing the switch S_2 in the collector supply of the audio oscillator.

Maximum r.f. output of this instrument is limited primarily by the curvature of the characteristic of the crystal diode. If the r.f. input to the modulator circuit is raised by increasing the number of turns on the secondary of L_2, the modulation envelope becomes unsymmetrical and distorted. The crystal modulator has very little loading effect on the oscillator, and incidental frequency modulation is small, not over a couple of hundred cycles at most.

There is a vast amount of published information on the design of transistor circuits, but there has not yet been time enough for all the important points to emerge in their proper perspective. Both the Hartley and the Colpitts circuits used here are fairly standard in the transistor art. The grounded-base connection used has the minor disadvantage of requiring two batteries, but has the advantage of not requiring any stabilization against drift, such as is required with grounded-emitter circuits. These oscillators behave much like their vacuum-tube brothers, although there is at least one important difference.

Operation is usually between class A and class B, rather than class C, for transistor oscillators. Thus, they are not very amenable to "plate," *i.e.*, collector modulation, although good results are obtainable (except for the incidental FM) if the right voltages, currents, feedback ratio, and load impedance are selected. Unfortunately, the circuit impedances change quite drastically over a 3 to 1 tuning range.

In a tube oscillator, during the negative swing of the half-cycle across the tuned circuit, the plate of the tube looks like an open circuit. In a transistor, on the other hand, the collector looks like a short circuit on the reverse half-cycle. It shunts the heck out of the tuned circuit and tries to put flat-tops on the output wave. At the same time it acts somewhat as a diode limiter and tends to keep the output voltage constant, although distorted.

The reverse collector current can be removed by inserting a crystal or other diode in series with the collector, as indicated in Fig. 5. The transistor here is assumed to be an *n-p-n* type, where the collector normally operates positive, and looks like a short circuit when you try to swing it negative. With a *p-n-p* transistor the diode must be reversed. At audio frequencies a method almost as effective is to insert resistance in series with the collector, to limit the reverse current (except in cases where power efficiency is important). This is the purpose of the 15,000 ohm resistor R_3 in Fig. 2. Best value is found by trial.

At r.f. the resistor produces serious losses by way of the collector capacitance. A crystal diode in series with the collector of V_1 does improve the r.f. waveform, but it also produces a change of about 3 to 1 in the amplitude of oscillation over the tuning range. It was therefore thought better to leave the crystal out, and make use of the amplitude-limiting properties of the transistor to get relatively constant output over the band. The waveform is still good compared to that of many vacuum-tube oscillators in this frequency range.

The "alpha cut-off frequency" of a transistor is the high frequency where the current gain has dropped 3 db. Transistors generally will oscillate at frequencies considerably higher than this, but with increasing dependence on the supply voltages.

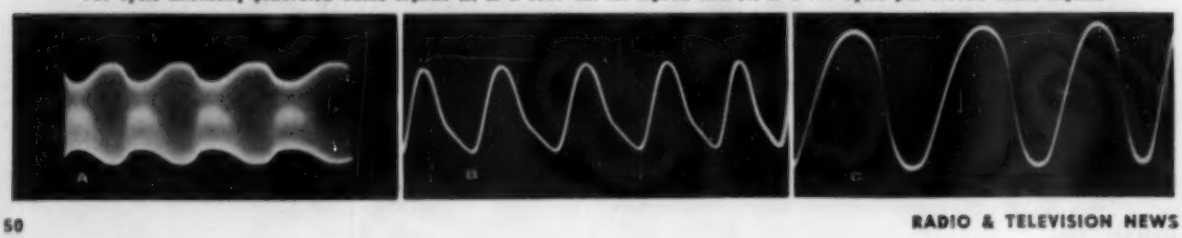
Fig. 6 illustrates the measured effects of collector supply voltage on the frequency of the r.f. oscillator. Measurements were made at two frequencies—600 and 1500 kc. At the lower frequency, as one expects, the per-cent change in frequency per volt change in collector supply is smaller. At both frequencies the effect is smaller at the higher values of collector voltage, where the transit time is shorter. At both frequencies at higher collector voltages, the frequency changes less than 1 per-cent for a 13 per-cent (2-volt) drop in supply voltage, which is stable enough for practical purposes.

A 100 per-cent change in emitter supply voltage (raising it from 1.5 volts to 3 volts) decreased the frequency 50 kc. or about 3 per-cent at 1500 kc; at 600 kc. the effect was much smaller.

The hermetically-sealed, metal-cased transistors are visible in Figs. 3 and 4 standing on their long, bent-over leads. It was deemed prudent to leave the leads full-length because of the danger of heat damage during soldering. These leads, incidentally, appear to be made of tinned, soft steel wire. This would be for the excellent reason that the thermal conductivity of steel is much lower than that of copper, as well as for matching the thermal expansion coefficient of the glass in the header.

It is perfectly practicable to hold the leads with the fingers about ¾-inch back from the ends while soldering the ends to the terminal lugs. Not only are the fingers uninjured; the heat is never felt at all if the soldering is done with only reasonable speed. This procedure is good insurance against damaging the transistor. —30—

Fig. 7. Waveform photographs of the signal outputs from the test oscillator. (A) is an r.f. waveform modulated with the 700 cycle internally-generated audio signal. (B) is a 1500 kc. r.f. signal, and (C) is a 700 cycle per second audio signal.



A MODERN FM CARRIER-CURRENT RECEIVER

★ By J. P. NEIL

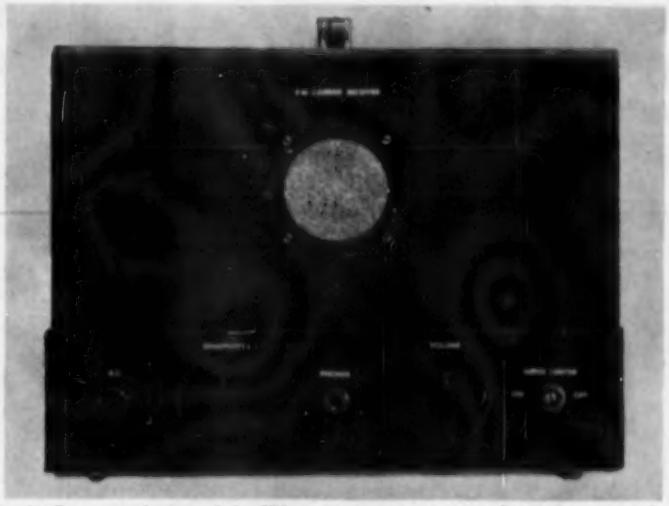


Fig. 1. Front panel view of the FM carrier-current receiver. It can be operated on either 148 kc. or 206 kc. depending on frequency selected by transmitter builder.

A companion receiver for the transmitter described last month. Any number of these units can be used in system.

THIS article will describe a 148 kc. (or 206 kc.) companion receiver to the FM carrier-current transmitter covered in the September, 1955 issue of RADIO & TELEVISION NEWS. As mentioned in the previous article, good reception has been obtained up to approximately a mile over domestic power lines. The limitation in distance was due only to a change of high-voltage distribution at the substation. Much greater distances should be possible, especially where applied to high-voltage lines by utilities.

Fundamentally this FM carrier-current receiver is conventional, consisting of two r.f. stages, two limiters, a Foster-Seely discriminator, and audio amplifier and power output stages. The r.f. circuits have been altered to broaden the frequency response. An additional "crash" limiter (*i.e.*, carrier off-noise limiter) has been added to quiet the receiver when the transmitter is idle. It is not intended as a noise limiter during periods of reception, since the limiter stages effectively squelch most of the transient noise. The tube line-up is as follows: V_1, V_2—6BD6 r.f. amplifiers; V_3—6AU6 1st limiter; V_4—6AG5 2nd limiter; V_5—6AL5 discriminator; V_6—6X4 rectifier; V_7—6AR5 pentode output stage; V_8—6AL5 squelch delay discharger; and V_9—12AX7 noise squelch-1st audio.

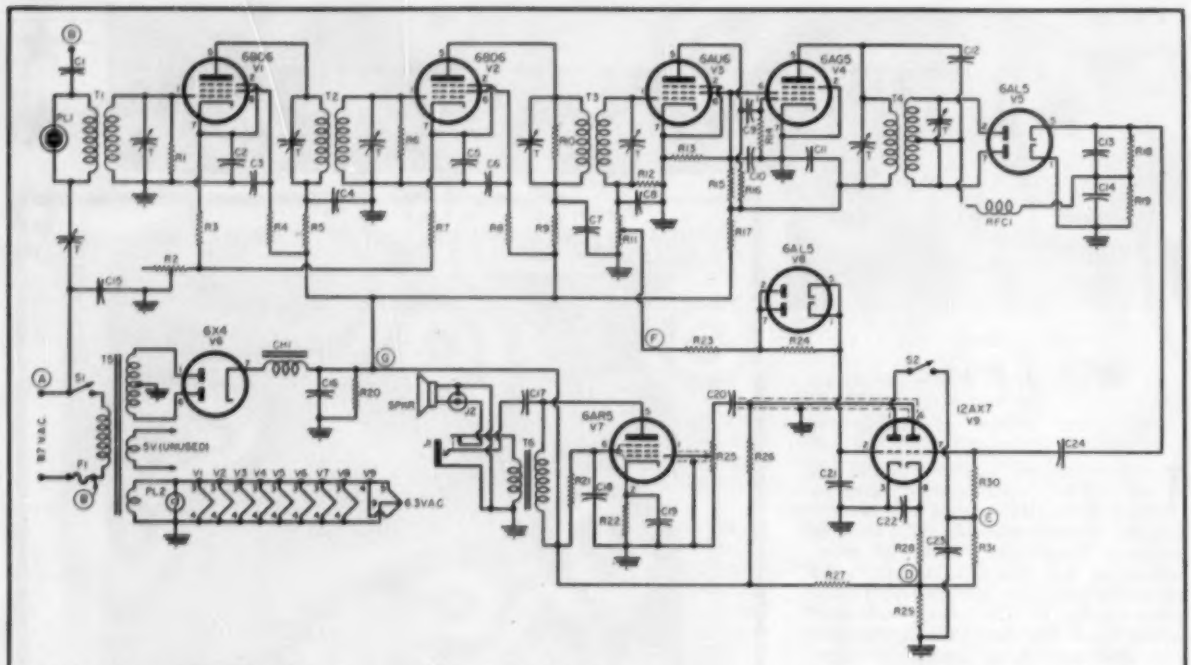
Circuit Details

The r.f. section (see Fig. 2) of the receiver uses standard *Miller* 112-K series 175 kc. midget air-core i.f. transformers which will tune the range of about 140 to 220 kc. T_1 is an input type, T_2 and T_3 interstage units, and T_4 a full-wave (center-tapped) output i.f. transformer. T_1 is modified in that the trimmer is (very carefully) wired in series with one side and an extra lead brought out. Care must be taken to see that the primary input is connected to line connections *A* and *B* exactly as shown.

Resistors R_1, R_5, and R_{10} are shunted across the various windings as shown, in order to broaden the frequency response of these normally relatively sharply tuned i.f. transformers. If other than the specified i.f. units are used, it will be necessary to be sure they are of the air-core, not iron-core variety. The latter would very likely be too high in "*Q*" even for NFM, in this case not more than 2 or 3 kc. deviation. The NE-48 neon bulb, PL_1, across the primary, has a two-fold purpose. It protects the primary against transient high voltage surges or burnout due to the receiver being operated on the same meter circuit as the transmitter.

Aside from good signal response, one of the most important considerations in power line carrier-current reception is random noise suppression. Precautions must therefore be taken to limit such interference as much as possible. The crash limiter which squelches noise when the transmitter is off, is a function of one half of V_9, the 12AX7, and V_8, a 6AL5. This system operates in the following manner. Under no-signal conditions with S_2 closed, a small positive voltage is impressed on the anode of the first section of V_9, while its grid is essentially at zero potential. This triode section therefore conducts heavily, causing a voltage drop across R_{23}. This drop, in turn, increases the bias on the grid of the second section of V_9 sufficiently to cut off the plate current, thereby preventing amplification of transient noise. Upon application of a carrier signal to V_8, a negative voltage is developed between the junction of resistors R_{31} and R_{32} and ground.

This voltage, applied as a bias above a certain critical value for a given plate potential, cuts off the first section of V_8, at which time the audio half of V_9 again operates as an amplifier. The magnitude of this negative voltage will depend upon the proximity of the transmitter to the receiver. On the same meter circuit it may be as high as 40 to 50 volts, whereas at a fringe location it may not be sufficient to bias the squelch section of V_9 to cut-off. When this latter condition exists, S_2 should be opened since the demodulated signal would then be attenuated as well as the noise. The values of resistors R_{31}, R_{33}, and R_{37} have been chosen to permit effective operation of the noise limiter with the weakest possible signal, consistent with the minimum cut-off bias value for the audio portion of V_9. (More about this under "Operation and Adjustments"). When a negative voltage is applied to the grid of the triode noise limiter, it charges C_{31} in series with R_{33}, R_{35}, and R_{37} relatively slowly in about ¼ second. With the carrier cut off, C_{31} discharges in about 2½ millisec-



R_1, R_3, R_6, R_{23}, R_{19}—100,000 ohm, ½ w. res.
R_2—10,000 or 20,000 ohm wirewound pot (see text)
R_4, R_7—470 ohm, ½ w. res.
R_5, R_9, R_{12}—2000 ohm, 1 w. res.
R_8—47,000 ohm, ½ w. res.
R_{10}—100,000 ohm, ½ w. res. (for 148 kc. only)
R_{11}—250,000 ohm pot (screwdriver adj.)
R_{13}—150,000 ohm, ½ w. res. (for 148 kc. only)
R_{14}—330,000 ohm, ½ w. res.
R_{15}, R_{17}—47,000 ohm, 1 w. res.
R_{16}—4300 ohm, ½ w. res.
R_{18}—30,000 ohm, 4 w. res. (two 100,000 ohm, 2 w. units in parallel)
R_{21}—6800 ohm, 2 w. res.
R_{22}—470 ohm, 1 w. res.
R_{24}, R_{30}—240,000 ohm, ½ w. res.
R_{26}—4.7 megohm, ½ w. res.
R_{27}—500,000 ohm pot
R_{28}—150,000 ohm, 1 w. res.
R_{29}—3300 ohm, ½ w. res.
R_{31}—8200 ohm, 1 w. res.
R_{32}, R_{33}—470,000 ohm, ½ w. res.
C_1, C_{21}, C_{22}—.05 μfd. disc or tub. capacitor
C_2, C_3, C_4, C_5, C_6, C_7, C_{20}, C_{23}, C_{25}—.1 μfd., 600 v. capacitor
C_8, C_9, C_{11}, C_{13}, C_{17}—.001 μfd. disc or mica capacitor
C_{12}, C_{18}, C_{24}—.005 μfd. disc or mica capacitor
C_{16}—30 μfd., 450 v. elec. capacitor
C_{19}—.02 μfd. disc or tub. capacitor
C_{10}, C_{26}—10 μfd., 50 v. elec. capacitor
S_1—S.p.s.t. line switch (on R_{11})
S_2—S.p.s.t. toggle switch
F_1—1 amp 3AG fuse ("Slo-Blo")
PL_1—NE-48 neon bulb with double-contact bayonet socket
PL_2—Pilot lamp with red jewel bracket
J_1—Three-circuit, normally-closed panel jack
J_2—Phono jack
Spkr.—2-inch PM speaker
CH_1—15 hy., 70 ma. choke
RFC_1—60 mhy. r.f. choke (Miller #693)
T_1—Midget air-core 175 kc. i.f. trans. (Miller #112-K1)
T_2, T_3—Midget air-core 175 kc. i.f. trans. (Miller #112-K2)
T_4—Midget air-core centertapped 175 kc. i.f. trans. (Miller #112-K3)
T_5—Power trans. 300-0-300 v. @ 70 ma.; 6.3 v. @ 4 amps; 5 v. winding not used
T_6—Output trans. 15,000 ohms to 4 ohms
V_1, V_3—6BD6 tube
V_2—6AU6 tube
V_4—6AG5 tube
V_5, V_8—6AL5 tube
V_6—6X4 tube
V_7—6AR5 tube
V_9—12AX7 tube

Fig. 2. Complete schematic of carrier-current receiver. Note that some of the parts are required only if unit is operated on 148 kc. frequency.

tonds or less through R_{11} and R_{13} because V_8 now has a positive potential from this capacitor on its anodes, hence V_8 conducts and effectively shorts out R_{13}. The purpose of this delay system is to allow for bursts of high intensity interference, of short duration, which would otherwise bias the squelch system and render it inoperative. The time delay therefore lets the noise burst pass on unnoticed before it has time to act as a bias on the crash limiter. Use of an external ground may, under some conditions, help reduce noise in severe cases, such as from fluorescent lamps or low frequency induction furnaces or arc welders. Switch S_2 is only provided to eliminate noise suppression with very weak signals or on quiet lines. Under fringe conditions, squelch operation may be improved by removal of R_{16} and R_{18} on the 148 kc. band.

The output stage V_7 is conventional in operation. A screen-dropping resistor R_{21} was added merely to limit the plate current to about 15 milliamperes. This resistor and C_{18} can however be eliminated if desired. Jack J_2 permits use of headphones, the receiver of a telephone handset, or a tape-recorder for police and security applications. The 2-inch speaker is connected *via* a standard phono plug and jack to the output transformer T_6 through the upper contact springs of jack J_1.

The power supply uses a choke input system for good regulation. A bleeder consisting of two 100,000 ohm, 2-watt resistors in parallel is shunted across C_{16} only to discharge this capacity, not to control no-load regulation. If the power transformer has a 5 volt rectifier filament winding, it will not be required due to the use of the separately-heated cathode rectifier tube V_6, a 6X4. The line plug should be marked with a colored spot corresponding to Terminal *B*, to indicate the "hot" side of the line.

Mechanical Construction

The physical layout of this receiver is built around an *ICA* No. 3981 8" wide by 12" long by 9" high standard amplifier foundation kit finished in grey wrinkle lacquer. The reason for this choice is that this unit was the only one available which would take the 2" PM speaker in the center between louvres. A piece of matching grille cloth is placed over a suitable hole cut in the cover. See Fig. 1.

Fig. 3 shows the top chassis layout while Fig. 4 is the bottom view of the chassis with the accessory bottom plate removed. This plate is fitted with four rubber feet and has twelve ⅜" diameter holes in it for ventilation. The plate is attached to the lips on the under side of the chassis by means of self-tapping screws. Ventilation holes were also drilled in the chassis top as shown in Figs. 3 and 4. The main components are labelled in Fig. 3 to show what was found to be the most convenient layout. Since the chassis is painted on both sides, before mounting the transformers, J_1, J_2, C_{18}, sockets, and various solder lugs and terminal strips, the paint should be scraped off on the under side. A ground terminal is mounted underneath the fuse on the rear lip of the chassis. See Fig. 4.

The power transformer T_5 is of the recessed horizontal mounting type. The filter choke, CH_1, is mounted on the under side of the chassis with its coil at right angles to T_5. The pilot bracket PL_2, r.f. sensitivity control R_7, J_1, R_{23}-S_1 the gain control-line switch, and S_2 the noise limiter switch, are all attached to the front edge of the chassis. R_{11}, the noise squelch bias control, may be seen in Figs. 3 and 4 between T_5 and T_1. The shaft of R_{11} is slotted for screwdriver adjustment. The r.f. choke (RFC_1) is near the lower right-hand corner of Fig. 4. It is mounted on a 1½" x 6-32 nickel-plated brass machine screw, and spaced at least ½" from the chassis. T_6, the output transformer, is also on the under side immediately behind J_1. All tubes are shielded except V_6 and V_7.

Wiring should follow normal techniques, with the shortest possible r.f. and a.f. leads. Note that the leads from the audio plate (pin #6) of V_6 and that from the arm of R_{23}, the gain control, to the grid of V_7 are both shielded to reduce possible hum pickup. The twisted leads from the line switch S_1 to a five-lug terminal strip (attached to rear lip of chassis beside the neon bulb, PL_1), are run around the edge (left-hand side in Fig. 4) behind T_5 and CH_1. Bypass and coupling capacitors may be mounted in the most convenient positions, with the leads as short as possible. Several lug-type terminal strips are judiciously placed throughout the wiring. The strip to which the line switch, T_5 primary, and line leads are connected also serves as a junction point for the leads from T_1 and the neon bulb. A twisted pair about one foot long, with a standard phono plug on one end is connected to the speaker. This will permit r.f. alignment (tone-modulated) aurally with the chassis cover removed.

Operation and Adjustments

After all wiring has been completed, checked, and found free from errors or poorly soldered joints, all tubes except V_6 should be inserted in their respective sockets and the line voltage switched on. If all tubes light and filament voltage appears normal, switch off the power and install V_6. Turn on the power and check the high voltage under load at point G. This should be approximately 240 or 250 volts d.c. Hum level can also be measured at this same point on an a.c. vacuum-tube voltmeter. The ripple voltage should be less than 0.25%. If much in excess of this value, C_{28} and CH_1 should be checked for correct values and possible leakage.

Now switch off the receiver and temporarily disconnect the A and B line leads of T_5 (with line plug removed from the outlet momentarily). Using an audio signal generator which will reach the 200 kc. region, temporarily connect the T_1 input leads to the generator. During the alignment procedure S_2 should be left open, and sensitivity and audio gain controls set in the full-on position (maximum clockwise positions). Switch the power on again and connect an a.c. vacuum-tube voltmeter successively from plate to ground on V_1, V_2, and V_3, peaking the primaries and secondaries of T_1, T_2, and T_3 for maximum output at 148 kc. or 206 kc. as the case may be. To adjust the final limiter V_4, connect the v.t.v.m. across pins 2 and 7 of V_5. If by chance one lead of the v.t.v.m. is grounded to its metal case, the instrument should be insulated from direct contact with the receiver chassis or true ground. Peaking both sides of T_4 will complete the initial alignment process.

If the receiver will not normally be operated on the same meter circuit as the transmitter, connect the A and B leads of T_5 back in place, and temporarily shunt the neon bulb with a 100-ohm, 1-watt resistor. Leaving R_2 and R_{23} full on, fire up the transmitter and modulate it with a single tone, say 1000 cps. Now re-peak all the r.f. transformers with the v.t.v.m. and a 4-ohm, 1-watt resistor across J_2 to momentarily replace the speaker voice coil.

If the builder has a sufficiently good ear, this peaking can be done by listening to the speaker. Note that if the receiver is to be operated fairly close to the transmitter, the 100-ohm resistor mentioned previously and a s.p.s.t. switch should be permanently mounted on the rear of the chassis so the resistor can be cut in or out of the circuit as necessary. Without this resistor, under such conditions, the neon bulb will light up and the primary of T_5 may be overloaded.

To check and adjust the crash limiter circuit, connect a d.c. vacuum-tube voltmeter between points D and E. With S_2 open, the meter should read around 12 volts. With S_2 closed and no signal, this voltage should drop to about 8 volts or so. Switch on the transmitter carrier (using the 100-ohm resistor across T_5) and adjust

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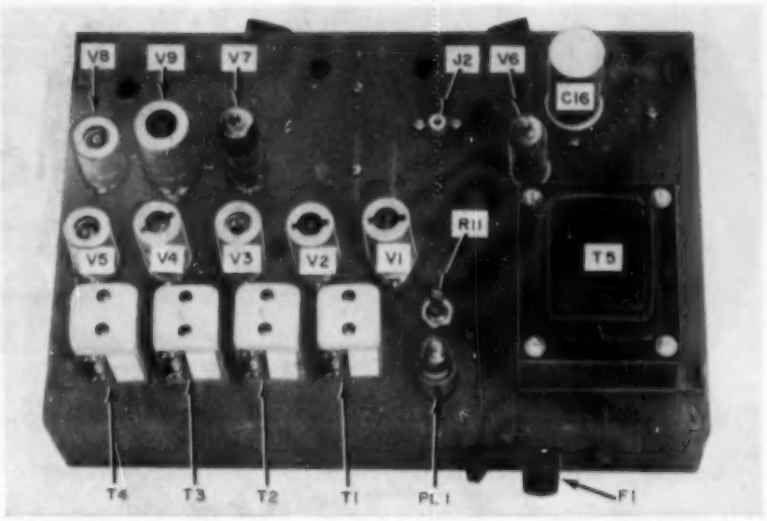


Fig. 3. Top chassis view of receiver. It is built on an 8" x 12" x 9" foundation.

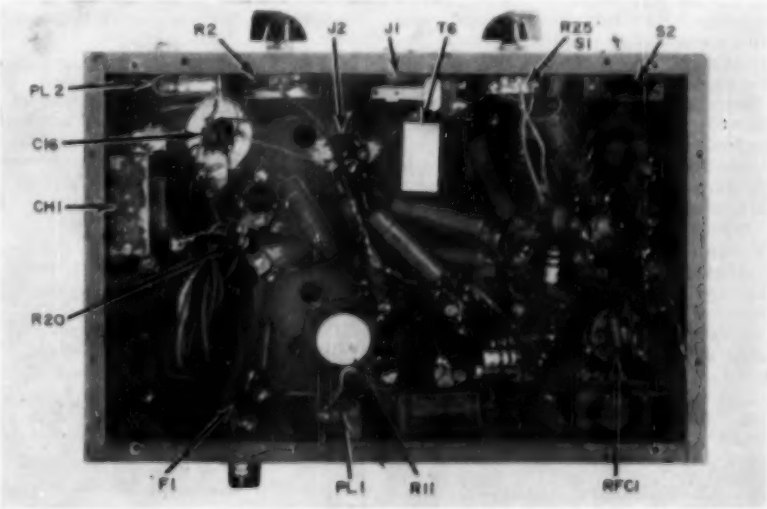


Fig. 4. Under chassis view with major components identified. See parts list, Fig. 2.

TRAINING the Radio-TV Service Technician

By LOUIS E. GARNER, JR.

Want to be a radio, TV, and audio service technician? Your best bet is to get professional training, and here is a guide to the various types of training courses available.

THE prospective radio-TV service technician desiring to become professionally trained has three possible paths which he can follow to achieve his desire (Fig. 1). He can go to work at an established service shop as an *apprentice;* he can enter a *resident school,* either on a full- or part-time basis (some schools offer evening classes for those who wish to keep their present jobs); or he can take a course from a *correspondence school.* All three paths offer means to obtain the necessary training. In fact, it is even possible to use a combination of these three methods to obtain the necessary background.

More important than the type of training, however, is the content of the training and the student's personal approach to the training. For example, a job as an apprentice in a service shop operated by an unscrupulous manager may result in the prospective service technician obtaining little training of value. He may find that he is considered simply as a low-paid flunky to do the dirtier and more difficult jobs.

Attending a resident school may seem, on this basis, to offer a better solution. But this is not necessarily the case. Some resident schools emphasize either the engineering approach or the station-operation approach in their training. While such sources are excellent as far as training factory technicians and radio operators, respectively, are concerned, they may be of doubtful value as far as day-to-day receiver servicing is concerned.

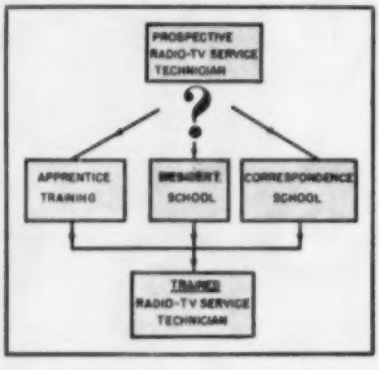
Similarly, the content of a correspondence school course should be investigated—make sure the course offered is designed to train a prospect to be a good service technician. As far as correspondence training is concerned, there is another factor to consider—the prospective service technician's personal approach to his training. No course of training is a magic wand that will transform an unskilled man into a professional technician overnight. Plenty of hard work is involved. In correspondence training, more than any other, it is the individual's attitude that will determine the value of the training. An earnest, hard-working student may be able to obtain better training from a mediocre correspondence course than the lazy, lackadaisical student can obtain from the best correspondence or resident course available.

Training Survey

In order to best determine the type and degree of training that prospective service technicians should have and expect, irrespective of how the training is obtained, the author conducted a survey among the group of men who know the servicing field best, the men who actually hire service technicians and who know, better than anyone else, what the service technician should know and what training he should have received. By correspondence and by personal contact a number of service managers of outstanding servicing shops were questioned. A number of questions were asked and the answers carefully noted.

It was found that the majority of service managers agreed very closely on their answers. So closely, in fact, that it was a simple matter to prepare composite answers to each of the questions asked, the composite answer representing the majority opinion. The questions asked and the answers obtained follow:

Fig. 1. Three general sources of training are available to the prospective TV service technician; which he chooses depends on personal factors as well as what he desires to do with his service course.



Q. *Which of the following inexperienced men do you find to be the best qualified: men who have served as an apprentice only, men who have received resident school training only, men who have received correspondence school training only?*

A. The man who has served as an apprentice is of more immediate value as a service technician. However, men who have received training, either in a resident school or by taking a correspondence course, are more valuable in the long run. The apprentice with no schooling is generally quite handicapped.

Q. *Which of the following experienced men do you find to be the best qualified: men who have no formal educational background, men who have received vocational or resident school training in addition to their experience, men who have received correspondence school training in addition to their experience?*

A. There is a 50-50 split on this question. About half the service managers queried said they preferred men who had received resident school training in addition to experience, and about half preferred men with correspondence school training in addition to experience. However, all agreed that they preferred to hire men who had schooling plus experience over men who had experience only.

Q. *Do you feel, on the basis of your experience with men you have hired, that resident schools, in general, give too much or too little theoretical training? Too much, or too little, practical training in servicing methods? Too much, or too little, actual practice in servicing sets?*

A. The majority of resident schools give sufficient theoretical background, but in some cases the engineering or mathematical approach may be overemphasized to the detriment of practical training in actual servicing meth-

ods. Practical training in actual service work is often neglected. Most of those queried felt that resident schools should alter the ratio of theory to practical work so as to allot more time to practical training. All felt that more emphasis should be placed on practical servicing experience.

Q. *Similarly, do you feel that correspondence schools give, in general, too much, or too little, theoretical training? Too much, or too little, practical training in servicing methods? Too much, or too little, actual practice in servicing work?*

A. The majority agreed that ample theoretical training is generally given by correspondence schools and that there is generally greater emphasis on the practical approach in this type of training (good). However, most felt that the emphasis on practical training was often lost due to the student working without personal supervision. In this respect, those schools offering experimental kits along with the theoretical training are to be recommended. In addition, care should be taken, in choosing a correspondence school, that personal consultation is available, and the student should make full use of this service in order to obtain the maximum from his training.

Q. *If a prospective employee came to you for advice, what type of training would you, personally, recommend: resident school, correspondence school, serving a period as an apprentice, or a combination of these?*

A. The majority of those queried said they would recommend resident school training followed by a period serving as an apprentice. However, the author feels that this answer should be qualified somewhat so as not to detract from the important and valuable job that correspondence schools can do.

The author has contacted and talked to a large number of service technicians (in addition to doing considerable service work himself). It has been his experience that the majority of students who take correspondence school training and eventually become full-time professional service technicians start by doing spare-time work. Usually the servicing will be carried on from a spare room or basement in the student's home until the amount of work received and the student's ability and skill have advanced to the point where servicing becomes a full-time job.

Thus, many correspondence school graduates who actually enter the servicing field (it should be noted here that many correspondence school students take the training more as a hobby, than with the idea of entering the field professionally) eventually have their own businesses, operating either a one or two-man shop. Because of this, the average service manager will generally not encounter as high a percentage of correspondence school graduates looking for work as he will resident school graduates and former apprentices.

Q. *Do you feel that TV servicing requires a more skilled man than radio servicing? Do you feel that a greater knowledge of circuitry is necessary?*

A. Without exception, every man queried agreed that greater skill and a greater knowledge of circuitry was required if the service technician was to do a good job of TV servicing than for radio servicing.

For the man already in radio servicing who plans to eventually expand into TV servicing, it would appear worthwhile to consider either taking time to attend a residence school for a short course specializing in TV or else to take one of the correspondence courses offering specialized training in this field.

Q. *Are there any personal comments or suggestions you would like to make?*

A. All of those queried had a number of suggestions or comments. The majority, however, tried to list additional items which they felt any course of training should cover, in addition to actual technical training.

Customer relations was one important field that the service managers thought needed emphasis. There is a definite need for better training of technicians in the matter of practical psychology; how to act towards customers, what to say, what to do, and, just as important, what *not* to say or do. Emphasis on tact is important. Service managers have sometimes had to discharge men who were top-notch technicians but who had the unfortunate trait of antagonizing customers. Neatness is important too, especially where work is done in the customer's home.

The managers also felt that any course of training should offer some background in business methods: profit and loss, elementary bookkeeping, how to price jobs, taxes, insurance, etc. This is not as important to the service technician who always plans to remain an employee at the technician level as to the man who either plans to eventually have a business of his own or who plans to work towards advancement to high level jobs (shop foreman, service manager, etc.). But in any case, a knowledge of business methods is helpful.

Content of Training

Irrespective of the type of training the prospective radio-TV service technician decides to take, he should make sure that certain fundamentals are adequately covered in the course. First, he must remember that the top-notch service technician needs a technical background composed of three important factors (see Fig. 2): theory, mechanical skills, and experience. Let us discuss each of these factors separately.

Theory. In order to properly understand circuits and in order to best apply his skill in servicing sets rapidly and efficiently, the technician needs an adequate and reasonably thorough background in theory. Any course of training should adequately cover the fundamentals: Ohm's law, inductive and capacitive circuits, filters, tuned circuits, power supplies, fundamental tube action, amplifiers, oscillators, transformers, basic circuits (clippers, multivibrators, reactance tubes, etc.), etc. In addition, training in analyzing circuit operation is important, particularly where the technician may encounter new circuits from time to time in his practical service work.

An engineering or mathematical approach to theory is not only not necessary but, in many cases, undesirable. Remember that the service technician's job is to repair an existing receiver and to place it in the original operating condition, not to redesign and rebuild it. Some mathematics is necessary to a proper understanding of circuit operation, and where mathematics is encountered, the student should make every effort to master it as well as the theory.

The theoretical background given should be adequate so that the technician can understand not only existing circuit operation, but also read and understand new circuit descriptions which appear from time to time in technical journals in the radio-television-electronics field. Only by keeping up-to-date in this fashion can the service technician continue in his field successfully.

Mechanical skills. Any course of training should offer adequate practice in the mechanical skills which the technician uses in his day-to-day work. The technician must be able to use hand tools (diagonal cutters, long-nose pliers, screwdrivers, hammer, soldering iron, wirestrippers, wrenches, etc.) with ease and facility. The ability to solder well is particularly important, and too much emphasis cannot be placed on this important job. A properly trained technician should have no difficulty in recognizing and in doing top-notch work.

Some training in the use of basic power tools should be given, although the average technician should seldom have need to use power tools other than the drill press and portable electric drill.

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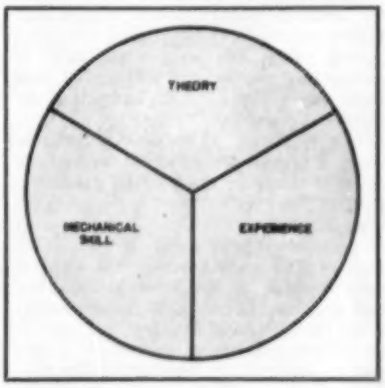
Fig. 2. Any formal course of service training should include the three parts shown here to insure a well-rounded technician.

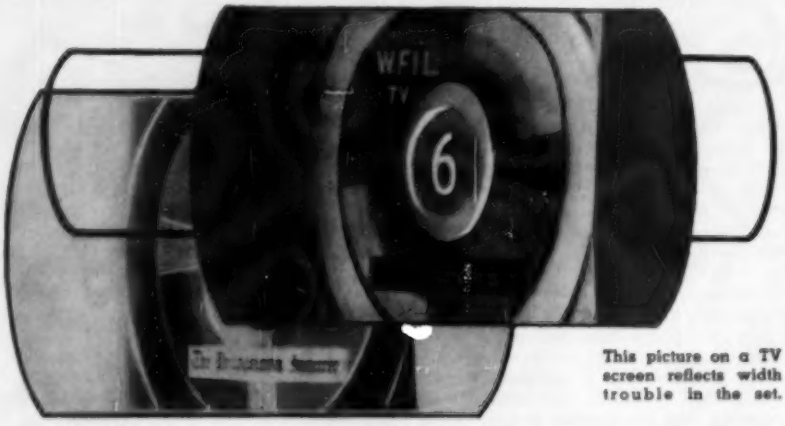


WIDTH

Troubles in TV Receivers

By **SOL HELLER**

Why does the picture on a TV screen decrease in width? Here are the answers plus some practical service hints.



This picture on a TV screen reflects width trouble in the set.

SIZE troubles are common in TV sets, and the defects involved are many and varied. Most often, the problem is one of decreased width and this is the subject which will be discussed here, although some suggestions for increasing height will also be given.

Insufficient Width

When a loss in width is caused by trouble in the horizontal yoke, a keystone-type or trapezoidal raster will generally be produced. The sides of the raster will slant in this case, and while some reduction in the raster height may be present, a considerably greater loss in width will generally be noted. A short in only one or two turns of the yoke can produce these symptoms. Resistance checks may not reveal the trouble, since the d.c. resistance of the yoke is not appreciably altered by such a partial short.

Many service technicians are apt to discard the original yoke, when substitution of a new one eliminates symptoms. This is not, however, a wise procedure, unless the capacitor that is generally connected across one-half the horizontal yoke has first been tested for leakage. This capacitor, C_{sh} in Fig. 1, is wired to the yoke, inside the yoke casing. If it has become partially or completely short-circuited, it will produce the same kind of symptoms as some yoke defects.

The capacitor is usually a ceramic type; improper dress of its leads may cause a short across part of the yoke. Inspect the lead dress of the capacitor, then resistance check it (with one of its pigtails disconnected); if these tests absolve the capacitor of blame, the yoke should be replaced by another one, and results noted. If the capacitor is found defective, another one should be substituted; if its lead dress is improper, correct it, insulating its pigtails as well as its body, when necessary, to prevent a recurrence of the trouble. The service procedures described can, in many cases, be performed without pulling the chassis from the cabinet.

In *RCA* models T-164, TC-165, 166, 167, and 168, improper dress of leads that go to the terminals of the horizontal yoke tends to cause arcing and short-circuits between these leads and horizontal yoke windings with which they come in contact. If resistance checks made at the yoke socket contacts (yoke plug removed) change when the Bakelite cap of the yoke is squeezed, the lead dress is most likely to blame. Poor solder connections or a defective yoke-balancing capacitor may, of course, also be the source of the symptoms.

An internal short in a width coil may be responsible for a loss in horizontal size. Disconnect one end of the coil and resistance-check it, as a test. The reading obtained should be compared to the one listed in the set schematic.

Common sources of insufficient width in the horizontal output circuit include a defective tube, increase in value of the tube's screen resistor, loss in capacitance or a leak in the screen bypass capacitor, and an open cathode bypass capacitor.

A horizontal output transformer with a loose core, due to a loose bolt, may be the source of a reduction in width. A 15,750-cycle squeal that is much more audible than usual will generally call attention to this defect. Tighten the bolt, to eliminate this source of trouble.

In *Setchell-Carlson* TV receivers using chassis 152 and 153, a slight change in the characteristics of the horizontal output transformer core gap may produce insufficient width, as well as horizontal foldover. If no other trouble can be found, the upper core bracket on the transformer should be taken off, and the tape originally used as a spacer removed. Two layers of *Minnesota Mining* "Scotch" cellulose tape, No. 600, should next be added evenly at the points where the original tape was found. Any foreign particles found in the air gaps should be removed, and the upper core bracket replaced. Replacement of the 68-ohm 6BQ6 screen resistor with a 150-ohm, 2-watt unit will complete the repair.

A defective horizontal oscillator tube may be the cause of insufficient width. Insufficient width may also be due to a defective blocking oscillator transformer. Low brightness and impaired horizontal sync are apt to be associated symptoms. The signal output of the oscillator will be below normal when such trouble exists. Even when voltage and resistance checks do not point to the transformer as the source of trouble, it should be replaced, if no other defect can be found, and results noted.

Coupling capacitors (interstage and feedback) across which a large difference in potential exists, are likely to break down and become leaky, reducing width (as well as introducing other symptoms). Losses in capacitance may also occur in these components. Look for these defects before other less likely ones are investigated. One of the quickest checks for a defect in a coupling capacitor is to scope-test the signal waveform at each side of the capacitor. If a considerable difference in amplitude exists, trouble is indicated—unless, of course, the capacitor is used to reduce the signal amplitude, as well as to couple it. Tests on coupling and feedback capacitors in normally operating receivers will familiarize the technician with the signal amplitudes to expect.

A bad damper tube will reduce width (usually impairing linearity and brightness as well). Defects in "B+" boost capacitors are also likely sources of trouble, due to the larger voltages often developed across them. Horizontal nonlinearity and vertical-bar effects are likely to be associated with troubles in these capacitors. In *Motorola* chassis TS-292, a loss of capacitance or open circuit in C_{22} (see Fig. 2) will not only reduce width, but will also cause four white vertical lines or bars to appear on the left side of the raster. A clue to the trouble lies in the variations of size and brightness that rotation of the horizontal hold control will introduce in such circumstances.

A weak low-voltage rectifier may be responsible for reduced width, and should be checked for by substitution early in the troubleshooting sequence.

Increasing the Width

In many cases the technician finds, after he has repaired a set, that the picture does not quite fill the mask. Aging of tubes is often responsible for the trouble; operation of the set in a low line-voltage area will intensify the symptoms. Adequate width may be obtained by replacing four or five tubes, but the customer may not be willing to stand the expense, particularly if the repair of another (major) trouble is going to set him back a considerable sum of money. When a "stripped-chassis" receiver that originally cost $100 or thereabouts is being worked on, it becomes particularly essential to keep repair costs down. One of the following methods of inexpensively obtaining a half inch or so of extra width may be used in such cases.

The commonest way of adding a small amount of width is by shunting the width coil with a 600-volt capacitor, anywhere from .001 to .1 μfd. in capacitance. Width is increased because the high voltage is reduced; the decreased "stiffness" of the electron beam causes it to sweep a greater distance, vertically as well as horizontally. The smallest value of capacitance capable of producing the necessary increase in width should be used, to avoid reducing the high voltage any more than is really necessary. The capacitor can generally be added without pulling the chassis from its cabinet, since the width coil (when one is present) is usually located in the high-voltage cage.

The high voltage may be reduced in many other ways, to effect a slight boost in width. One method consists of adding a resistor in series with the high-voltage filter resistor (R_{22}, Fig. 1). If the filter resistor present is around 500,000 ohms, another resistor of approximately the same value may be added, bringing the total to 1,000,000 ohms. (It's better to use two half-megohm resistors in series, than a 1-megohm resistor by itself, to avoid excessive and possibly damaging surge voltages across the filter resistance.)

Another method consists of shunting the horizontal yoke with a capacitor. The unit used should not exceed 470 μμfd., and should have a 2 to 3 kilovolt breakdown rating.

If the high-voltage filter capacitor is returned to a "B+" voltage point instead of chassis (as C_{22} is in Fig. 1), connecting it instead to chassis will reduce the high voltage by several hundred volts, often increasing width in consequence. Sometimes, oddly, lifting the negative return of the filter capacitor from the chassis and connecting it to a "B+" voltage point will increase width. The reason for these apparently contradictory phenomena lies in the fact that the horizontal output circuit is very sensitive to capacitance changes. A certain amount of undamped ringing takes place in this circuit, causing ringing voltage peaks or valleys to be added to the desired sweep signal. A slight change in capacitance, such as that provided by the changing of the high-voltage filter capacitor return may shift the ringing voltage phase with respect to the desired sweep signal, so that a valley rather than a peak is added to this signal. The resultant reduction in high voltage will cause width to be increased. When the high-voltage filter capacitor return is shifted from ground to a "B+" supply point, it is quite possible that the reduction in high voltage due to the capacitance effects referred to will be greater than the increase provided by the addition of "B+" voltage to the high voltage.

Increasing the screen voltage of the horizontal amplifier tube is one way of increasing width. This is most readily achieved by using a smaller value of screen resistance. The method is recommended chiefly in low line-voltage locations. When the line voltage is high, the horizontal output tube is probably working at or near its maximum ratings; increasing the screen voltage is apt to cause these ratings to be exceeded, shortening the life of the tube. If the service technician wants to be certain that the tube ratings will not be exceeded, he can measure the screen and cathode currents (after the resistor substitution) and compare them with the maximum values for the tube, as listed in a tube manual.

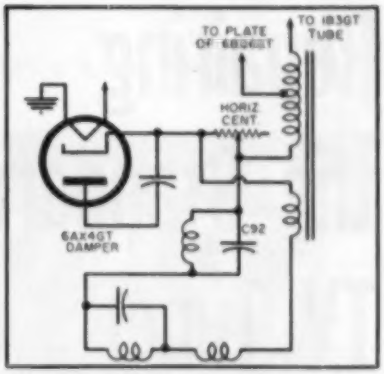


Fig. 2. Section of the damping circuit used in Motorola TS-292A and TS-324A TV chassis. A defective capacitor C_{22} will result in decreased picture width.

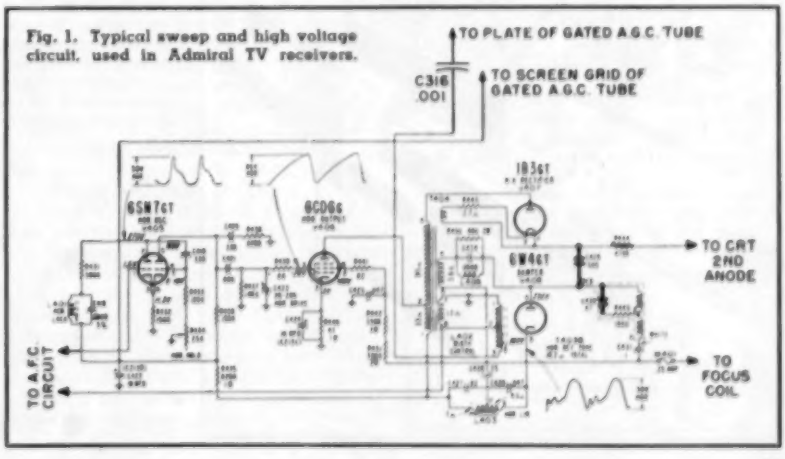
The bias on the control grid of the horizontal amplifier is sometimes reduced to provide a small increase in width. Effecting this decreased bias by reducing the cathode resistance is not recommended. The cathode resistor serves a protective function; when its value is reduced, danger to the horizontal amplifier in the event of horizontal oscillator failure becomes much more likely. Furthermore, substantial variations in amplifier output (due to fluctuations in sweep input signal) are promoted in the absence of a suitably large value of cathode resistance, increasing the tendency toward changes in picture size.

Some technicians boost width by reducing the drive to the horizontal amplifier, either by resetting the horizontal drive control, or by reducing the plate voltage of the horizontal oscillator. (The increase in width is due to the reduction in high voltage.) The procedure is unwise, since the reduced drive increases the heat dissipated in the horizontal amplifier and thus shortens its life.

Removal of the width coil is sometimes resorted to, to bring up the width. The terminals to which the width coil is normally connected are shorted together to complete the circuit. The coil cannot be removed, of

(*Continued on page* 166)

Fig. 1. Typical sweep and high voltage circuit, used in Admiral TV receivers.



Repairing the Standard Coil TV Tuner

By **ROBERT B. GARY**

A new replacement parts kit available at electronic parts distributors makes possible fast tuner repairs.

Fig. 1. Underchassis view of the type "F" Standard Coil TV tuner with the channel 9 coil strips removed. V.h.f. and u.h.f. coil strips for the tuner are shown at left.

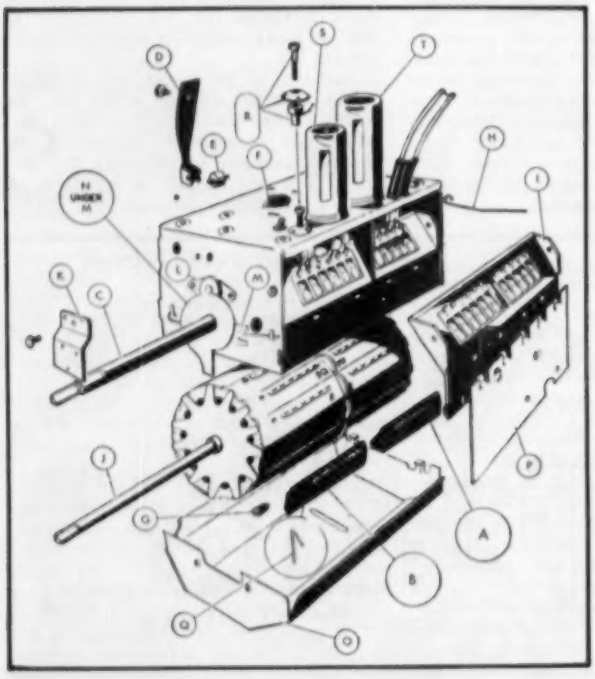


Fig. 2. Exploded view of the Standard Coil tuner. Most of the mechanical parts shown labeled are available in the complete parts kit for replacement purposes.

BY NOW, almost every service technician has had some encounter with the alignment and minor repair of the *Standard Coil* TV turret tuner. Until recently, most television receiver manufacturers recommended that tuners be sent back to the factory for repairs since the circuits therein are critical and more exact methods for handling tuners were set up in the factory.

Recently, however, *Standard Coil Products Inc.* has made available through radio distributors a complete kit of parts which enables the technician to repair almost any mechanical defect which might occur in their tuners. Spare coil strips, special channel strips, and u.h.f. adapter strips have been available all along, but now the technician can replace such important parts as worn-out contact springs, as well as broken detent and retainer springs.

Fig. 1 shows the underside of a typical *Standard Coil* tuner type "F," with the channel 9 coil strips removed and the desired u.h.f. adapter strips ready to snap into that space. The tuner shown here does not have the side and bottom shield found on most later models.

Fig. 2 is an exploded view of the tuner and gives some indication how the various components go together. The parts kit illustrated in packaged form in Fig. 3 contains practically all the parts that can become defective, for practically all models of the *Standard Coil* tuner. Included are the special ceramic capacitors, and i.f. and sound take-off coils which are not part of the average service dealer's stock. Half-watt resistors and similar parts which are available in every service shop, are not found in the repair kit.

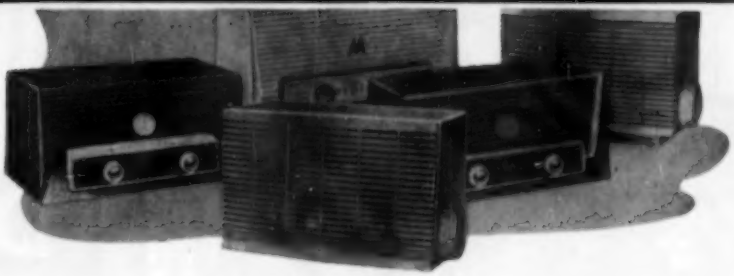
Assume that in a particular tuner the detent spring is weak, giving uncertain detent action. Some technicians may attempt to bend the flat spring, item "D" in Fig. 2, and in the process may break it. The repair kit contains the detent spring as well as the roller "E," and the replacement is made simply by removing the single screw holding the old spring in place and screwing the new one on. The boss in the chassis will line up with the second hole in the detent spring and thus locate it positively for proper action on the coil support assembly detent plate.

Occasionally, while replacing individual coil boards, the spider retaining

(*Continued on page* 174)

By BEN CRISSES & DAVID GNESSIN

Practical A.C./D.C. Servicing



Some practical hints on finding heater and "B+" troubles in a.c. – d.c. or three-way receivers.

THE a.c.-d.c. radio represents an excellent bread-and-butter income item and should be appreciated for the enormous volume of sales and service it accounts for. If the shop is big enough, one man should specialize in this item. If the shop is small, then the following procedures for handling transformerless sets may prove useful to the owner-operator.

In table model radios the heaters are generally in series. If one tube lights, all should be lit. See Fig. 1 for the simplest a.c.-d.c. heater string. In battery radios using low-voltage types (1A7, 1R5, 1U4, 3Q5, etc.) the tubes may operate so cool that it is difficult to tell by inspection if the filament is lit. If an ohmmeter is used to check continuity, the filaments must be checked on the *highest* scale, reading *short*. The resistance in the highest scale limits current, protecting the fragile filaments of very small tubes.

In combined a.c.-d.c.-battery sets, and in some battery sets resembling a.c.-d.c. sets, the tubes may not be in strict series filament string. Series-parallel and other complex filament circuits may be used. Check the schematic diagram if it is available. Don't assume that because one tube filament is lit all the rest of the tubes must have good filaments (thinking they must be in straight series string only). In certain a.c.-d.c.-battery sets the rectifier tube is directly across the line in a.c. use, lighting even if all the other tubes are burned out (and *vice versa*).

Heater strings with tubes drawing different currents have resistors in parallel, in different places.

Rectifiers of the 35Z5 type have three heater connections. Be certain that there is continuity between any two at a time, providing continuity among all three terminals. Pilot lamps are generally across one section of the rectifier heater. If the pilot bulb has burned out, check especially for continuity across that rectifier section which parallels the lamp. In an emergency, if you can't make a complete check where a pilot bulb has burned out, replace the bulb with an identical replacement, then gingerly insert the a.c. plug lightly, keeping your hand on it for instant withdrawal if required. If the bulb lights with more than normal brightness, quickly pull out the plug—you have trouble; probably need to replace the rectifier tube.

In an a.c.-d.c. receiver the chassis may not be the "B—" return. Check to see if one side of the a.c. line is grounded to the chassis (probably through the a.c. switch). If it is grounded to chassis, then a short from any part of the heater circuit to the chassis will complete part of the heater circuit, overheating that portion of the heater string and shorting out the remaining heaters. Fig. 1 illustrates this condition. If the faulty tube is near the end of the heater string, no particular damage may be done. However, a shorted heater near the hot end of the string will more than likely burn out tube heaters.

"B+" Checks

"B+" circuits in a.c.-d.c. sets are generally of the type shown in Fig. 2. The voltage at point *A* will be about 100 volts, while at point *B* it will be about 90 volts. If either of these voltages is noticeably low, the rectifier tube has lost emission, or there is a "B+" leak or short. Proceed as follows:

1. Open the rectifier cathode lead at *A*. If the voltage at the cathode is low, replace the tube. If the voltage is normal, proceed to step 2.

2. Resolder the cathode lead. Open the lead from point *B* to the rest of the set. If the voltage is below 80 volts, a leaky capacitor C_1 or C_2 is indicated. These capacitors are generally in a single housing with a common negative lead. If the voltage is now normal, skip step 3. If the voltage is low, proceed to step 3.

3. Open C_1 only at point *A* and measure voltage at point *B* again. If it is normal now, replace capacitor C_1. (If compatible with your business practices, replace entire filter group, C_1-C_2.) If the voltage at *B* is still low, leave C_1 open, and open C_2 also. The voltage at point *B* should now be normal. If it is, then wire in a new filter group, C_1-C_2. *With the new filter there will be a rise in output voltage due to capacitor storage action.*

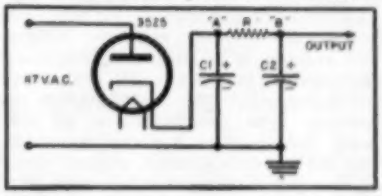
On the other hand, if the voltage at *B* is still low after opening that point, measure continuity across resistor *R* and check against manufacturer's data, if available. This resistor is generally around 1000 ohms. A jumper across it will give emergency continuity if an open is suspected. Replace the resistor if it reads high or open.

4. When voltage at *B* is normal, resolder all connections, including the connection to the rest of the set, and recheck voltages at point *B*. If the voltage is still low, trace the lead from point *B* to the plate circuits in the set and check for shorted capacitors to ground. Open the hot side of the capacitors one at a time, and measure the voltage at point *B* after each opening. Resolder each connection after reading voltage at *B* (if the voltage has not been increased) before opening any other capacitor lead. If the voltage *rises* after opening any particular capacitor, replace that faulty capacitor with a good one.

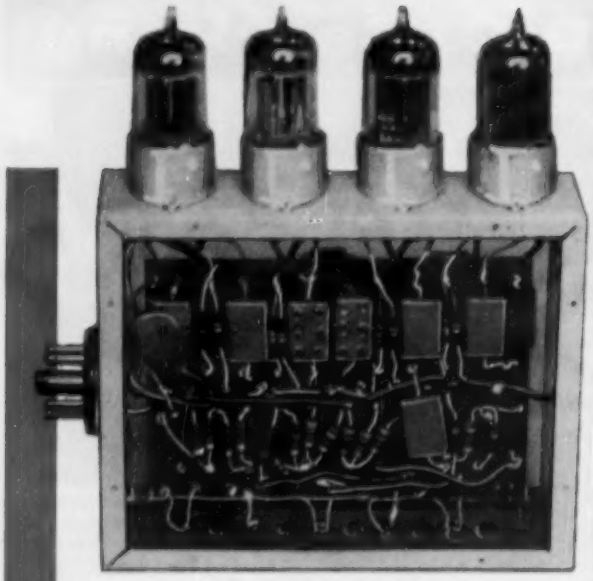
(*Continued on page* 126)

Fig. 1. The heater defect shown here is difficult to diagnose since two of the tubes will be lit and two will not.

Fig. 2. Typical "B+" rectifier circuit in an a.c.-d.c. receiver. Points "A" and "B" are test points for the filter.



The Electronic DECIMAL COUNTER



Over-all view of the author's home-built decimal counter. Several such units can be used in series if higher counts are required by the job.

By EDWARD K. NOVAK

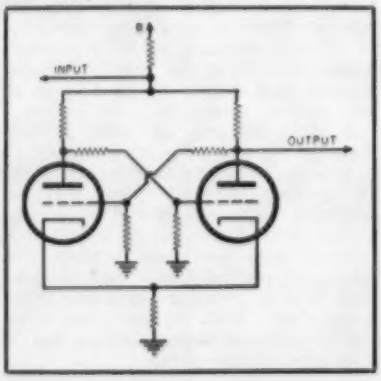
Construction details on a compact scaler incorporating a bistable multivibrator. It uses standard 12AU7 tubes.

WITH the advent of the age of guided missiles, electronic brains, and automatically-controlled production lines, the electronic scaler is gaining popularity and finding increasingly wider application. Where in previous years the scaler, or counter as it is generally called due to its more popular function, was used only in counting tasks requiring higher counting rates than those possible with mechanical counters, today scalers are found in an increasing variety of electronic devices ranging from simple unit counters to the highly complex control systems of guided missiles.

Basically, the scaler is a frequency divider. It is capable of dividing any number of input pulses by an arbitrary factor such as 2, 3, 7, etc., but usually 2^n or 10^n. Scalers, however, differ from conventional frequency dividers in that they are designed to operate aperiodically, that is, on signals arriving in a random fashion. Conventional frequency dividers, on the other hand, usually operate on resonant circuit principles and hence, require input signals that are periodic.

Because of their aperiodic nature and in order to be usable with random phenomena, practically all scalers in use today utilize the Eccles-Jordan, or bistable type, multivibrator as the basic circuit. Such a circuit has only two stable, or quiescent, states. One of the two tubes conducts while the remaining tube is cut off. When triggered by the proper type of input pulse, the conducting tube is cut off and the other tube conducts. The circuit remains in this condition indefinitely until another input pulse causes the circuit to revert to its previous state. Since each tube will flip from one state to the other with each input pulse and an output pulse is generated with each flip, then both positive and negative pulses will appear at the plate of either tube. Therefore, if the circuit is designed to accept pulses of one polarity only, say negative as in Fig. 1, and the same polarity pulses are utilized at the output, then one pulse will appear at the output for every two pulses applied at the input. Such an arrangement divides the input pulses by a factor of two. This is the fundamental principle of most scalers.

Fig. 1. Basic bistable multivibrator.



For obvious reasons it is desirable that a scaling device scale by a factor much larger than two. Therefore, several bistable multivibrators are usually connected in cascade, like the circuit of Fig. 3, which scales by a factor of 16. In this arrangement every sixteenth pulse applied to the input multivibrator results in a single output pulse from the output multivibrator, or 8, 4, and 2 pulses from the other stages, as indicated in Fig. 3.

The fact that the plate voltage of each of the tubes in each muitivibrator shifts from cut-off to its zero bias value, as the stages are flipped in accordance with the input pulses, can be utilized to actuate indicators which will show the number of input pulses that have been applied to the unit. This is usually accomplished by designing the multivibrator so that the voltage shift is sufficient to ignite a neon lamp connected to the plate of the output tube when that tube is cut off, or to cause the lamp to go out when that tube is conducting. As shown in Fig. 3, if the lamps at the output of each section are numbered, a count of the number of input pulses received is then determined by adding the number of lamps that are ignited. The waveforms of the scale-of-16 unit and the method of obtaining the count are shown in Fig. 2. For example, before the first input pulse arrives all even-numbered tubes (V_2, V_4, V_6, and V_8) are conducting. Since the plate voltage of these

tubes is low, the neon lamps connected to their plates will not ignite. The fact that no lamps are ignited indicates a count of zero. When the first pulse arrives V_1 and V_2 flip over. Now, since V_2 is cut off and its plate voltage is high, lamp number 1 ignites. When V_2 cuts off it also sends a positive pulse to the next multivibrator, V_3-V_4. Since the next multivibrator will respond only to negative pulses the circuit does not flip over and nothing further occurs in the rest of the circuit. Lamp number 1 is ignited and indicates a count of one.

Upon arrival of the second pulse V_1-V_2 again flips over. The plate voltage of V_2 drops, extinguishing lamp number 1, and sending a negative pulse to multibrator number two. Since the pulse is of the proper polarity to switch the multivibrator, V_3-V_4 flips over. The plate voltage of V_4 jumps to its cut-off value and lamp number 2 ignites, indicating a count of two. The third input pulse ignites lamp number 1 but does not disturb the rest of the circuit. Now since both lamps number 1 and number 2 are ignited the indicated total count is three. In a similar manner, the application of more input pulses will cause successive counts to be indicated by the lighting up of the proper lamps, as shown in Fig. 2.

To simplify this explanation, the scaler was assumed to be in the zero position before the first pulse was applied. This condition will not necessarily obtain at the beginning of a count, however, unless some provision is made to reset the unit. By referring to Fig. 2 it is seen that the scaler indicates zero whenever all even-numbered tubes are conducting, thus, the scaler can be reset if desired by causing this condition to obtain. In practice this is done simply by inserting a momentary circuit-breaking switch in the common grid return lead of the even-numbered tubes. Fig. 1 shows that an open grid return opens the voltage divider, consisting of the grid, plate, and coupling resistors, and returns that grid to "B+" through the coupling and plate resistors. Under these conditions the grid goes to zero bias and the even-numbered tube conducts—remaining in this reset, or zero count, state until a counting task begins.

The Decade Scaler

Because the science of numbers, as we know it, is based upon the decimal system and we tend to regard quantities in terms of decades or multiples of 10, the scale-of-16 system would present an unwieldy arrangement if counts greater than 16 were required. For this reason the scale-of-16 unit is usually permuted to a scale-of-10.

In order to effect a permutation from a scale-of-16 to a scale-of-10 it is evident that the equivalent of six input pulses must be added internally. Stated in another way, in order to effect the permutation the scaler must be forced to recycle at the count of 10 instead of at the count of 16. Fig. 3 shows one method by which these requirements can be met. Two feedback circuits are added to the basic scale-of-16 unit.

In operation the circuit functions as follows: The circuit counts as a conventional binary counter up to nine. On the count of ten the negative pulse from V_2 to the grid of V_7 cuts this tube off. V_8 flips back to its zero position, sending a negative pulse back to the grid of V_3 at the same instant as a negative pulse is being applied to the V_3-V_4 binary from the preceding binary. The large pulse fed back from V_8 overrides the pulse that is normally fed to stage two from stage one and prevents stage two from flipping over, causing this stage to remain in its zero position. Since stage two does not flip, no pulse is sent to stage three and it also remains in its zero position. Stage one is normally in its zero position at the count of ten. Thus, all stages are at zero, or no count, position and all neon lamps remain unlighted, which is the exact condition for zero count. See Fig. 4. Thus the circuit has recycled after 10 counts and is ready to begin the next ten counts. The equivalent of six input pulses, added internally in this case, is obtained by effectively adding two pulses due to the V_8-V_3 feedback, and subtracting eight pulses due to the V_3-V_7 circuit.

Clarifying further, if stage one flips once for every input pulse, stage two flips once for every two input pulses, stage three for every four input pulses, and stage four for every eight input pulses, then the internally fed back pulse from V_8 to V_3 is equivalent to two input pulses fed to input. Similarly the pulse fed from stage one to stage four is equivalent to —8 input pulses since a pulse fed from stage one to stage four arrives eight input pulses sooner than it would if it had to

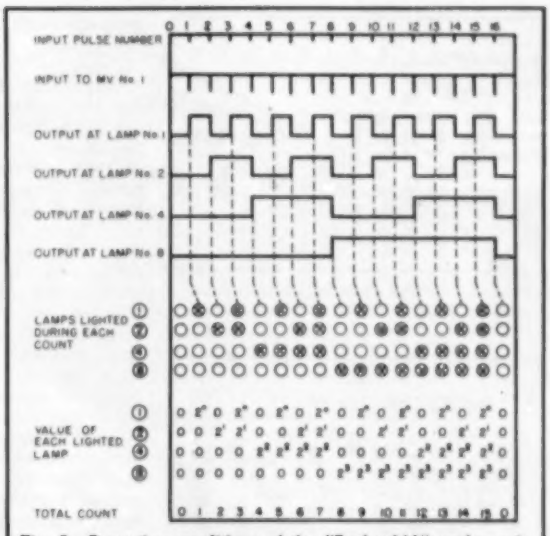


Fig. 2. Operating conditions of the "Scale-of-16" scaler unit.

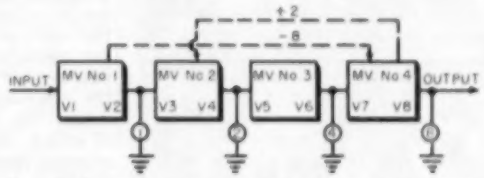


Fig. 3. Block diagram shows (omitting dotted feedback section) a cascade multibrator for "Scale-of-16" scaler. By adding the feedback (dotted), circuit is permuted to "Scale-of-10." See text.

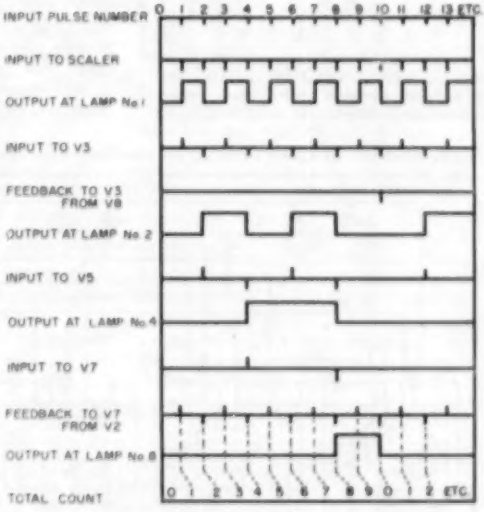
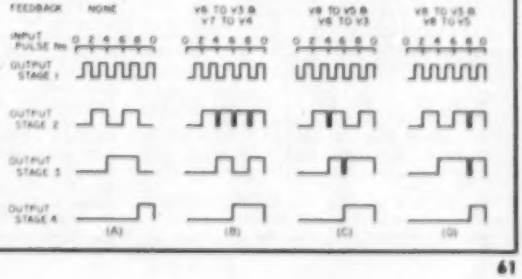


Fig. 4. Circuit waveforms for a binary system decimal scaler.

Fig. 5. Scaler waveforms for various feedback circuits. See text.



Lamp or count # →	0	1	2	3	4	5	6	7	8	9
Tube # ↓										
1	H	L	H	L	H	L	H	L	H	L
2	L	H	L	H	L	H	L	H	L	H
3	H	H	**L**	**L**	H	H	L	L	H	H
4	**L**	**L**	H	H	L	L	H	H	L	L
5	H	H	H	H	L	L	L	L	H	H
6	L	L	**L**	**L**	H	H	H	H	L	L
7	H	H	H	H	H	H	H	H	L	L
8	**L**	**L**	L	L	L	L	L	L	H	H

Table 1. Voltage chart for binary system readout decimal scaler. Refer to article. Connections indicated in bold face type.

Feedback	V_5 to V_4	V_6 to V_5	V_7 to V_6	V_7 to V_5	V_8 to V_7	V_8 to V_5
V_5 to V_4	12	12	12	10	10	8
V_6 to V_5		12	10	8	12	10
V_7 to V_4			14	10	14	10
V_7 to V_6				12	10	12
V_8 to V_5					14	10
V_8 to V_6						12

Table 2. Resulting scale factors for various feedback combinations in the scaler.

Lamp or count # →	0	1	2	3	4	5	6	7	8	9
Tube # ↓										
1	H	L	H	L	H	L	H	L	H	L
2	L	H	L	H	L	H	L	H	L	H
3	H	H	**L**	**L**	L	L	H	H	**L**	**L**
4	**L**	**L**	H	H	H	H	**L**	**L**	H	H
5	H	H	H	H	**L**	**L**	L	L	L	L
6	L	L	**L**	**L**	H	H	H	H	H	H
7	H	H	H	H	H	H	**L**	**L**	**L**	**L**
8	**L**	**L**	L	L	**L**	**L**	H	H	H	H

Table 3. Voltage chart for decimal system readout decimal scaler. See article. Connections indicated in bold face type.

pass through stages two and three.

The Decimal Counter

The decade scaler, as developed thus far, is capable of counting to any number and presenting this number by means of its indicators. However, a further improvement in the method of presentation is at once indicated since the count cannot be read directly but must be mentally computed for each decade by adding up the numbers indicated by the lighted neon lamps. A more convenient method of presentation is one involving ten indicator lamps numbered from 0 to 9, so that the count may be read directly. However, the method of connecting the ten lamps is somewhat more complicated than the four-lamp binary method, since it becomes necessary to find ten separate events (combinations of voltages) each of which is unique to only one of the ten lamps such that each lamp will ignite only once and at the proper time during a count of 10. In Table 1, compiled from Fig. 4, the letter *H* indicates that the tube at which the voltage is measured is cut off resulting in high voltage while low voltage is indicated by the letter *L*, when the associated tube is conducting. By design, the voltage difference between *H* and *L* is sufficient to ignite an indicating neon lamp. Referring again to Table 1, it is seen that if instead of connecting one end of each lamp to ground, one end of all even-numbered lamps is connected to the plate of V_3 and one end of all odd-numbered lamps is connected to V_5 only five different events will now be necessary to light the proper lamps at the appropriate time, thereby simplifying the problem somewhat.

Examining Table 1 further, it will be seen that if the other leads to lamps 0 and 1 are connected together and the common leads connected through isolating resistors to the plates of V_4 and V_5, lamp 0 will light on the count of 0; and lamp 1 will light on the count of 1. Similarly, if lamps 2 and 3 are connected together and to the plates of V_3 and V_4, only lamp 2 will light at the count of 2; and lamp 3 will light at the count of 3. This system, however, fails on the count of four because, as shown in Table 1, lamp 0 will again ignite since on this count the plates of V_4 and V_5 and, therefore, one end of lamp 0, are low while the other end of lamp 0 is connected to V_7 which is high. In order to resolve this difficulty V_7-V_8 must be forced to skip a count so that it will remain in its previous state during counts four and five. Assuming that this can be done, lamps 4 and 5 are connected together and to the plates of V_3 and V_5. With this arrangement the counter will work properly through the count of five. However, on the next count difficulties again develop. As was the case with the previous stage, the proper conditions for igniting the remaining four lamps in their proper sequence are determined and noted. The problem then is one of obtaining those conditions for each count.

Table 2 is a chart showing the total scale factor that will be obtained if the indicated feedback combinations are used. For example, if feedback is inserted from the plate of V_7 to the grid of V_6 and from the plate of V_8 to the grid of V_8 a scale factor of 10 will be obtained, meaning that the scaler will recycle every 10 counts as required for a decade counter. The chart shows eight possible combinations that will result in a scale factor of 10.

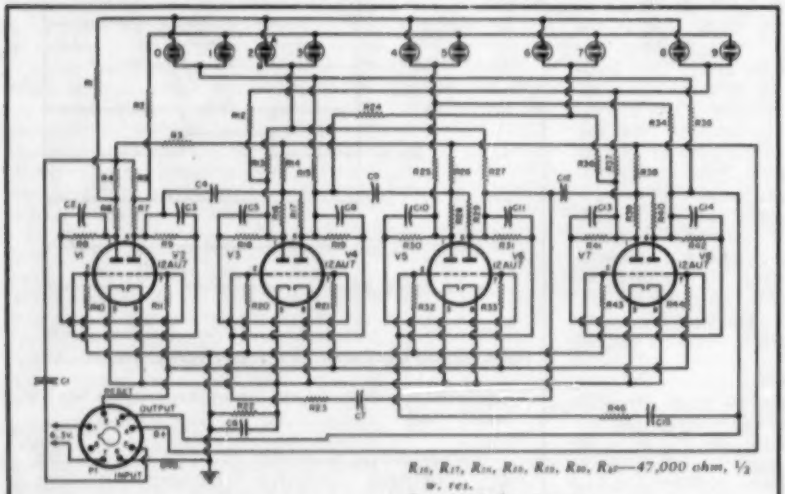
Many more combinations would be possible if feedback circuits including the first stage, V_1-V_2, were also charted. However, as noted previously the action of V_1-V_2 is already in use and hence cannot be disturbed by including it in a feedback circuit. As will be seen, investigating the last three stages only for the proper feedback combination to produce the required circuit action will be sufficient.

Fig. 5 lists operating conditions, or circuit waveforms, for several different feedback arrangements. A study of each of these arrangements indicates that the required operating conditions can be met by using Fig. 5D. This can be seen more clearly if the operating conditions are again charted as for the decade scaler.

Examining the chart, Table 3, it is seen that if end *A* of all even-numbered lamps is connected to the plate of V_1, and end *A* of all odd-numbered lamps is connected to the plate of V_2, while the *B* end of the lamps, taken in pairs, is connected to the plate of the tube indicated, proper presentation of the count will result. For example, on the count of zero, end *A* of lamp 0 is high. End *B* is connected to V_4 and V_5

(*Continued on page* 149)

Fig. 6. Schematic diagram covering the electronic decimal counter. Parts are standard.



R_1, R_2, R_3, R_{10}, R_{15}, R_{16}, R_{22}, R_{24}, R_{25}, R_{27}, R_{34}, R_{35}, R_{36}, R_{37}—220,000 ohm, ½ w. res.
R_2—27,000 ohm, 1 w. res.
R_4, R_5, R_6, R_7—22,000 ohm, ½ w. res.
R_8, R_{12}, R_{13}, R_{20}, R_{21}, R_{31}, R_{32}—270,000 ohm, ½ w. res.
R_{28}, R_{33}, R_{39}, R_{41}, R_{42}, R_{45}, R_{46}—120,000 ohm, ½ w. res.
R_{11}, R_{29}—47,000 ohm, 1 w. res.
R_{17}, R_{18}, R_{19}, R_{23}, R_{26}, R_{30}, R_{40}—47,000 ohm, ½ w. res.
R_{38}—3900 ohm, 1 w. res.
R_{44}—100,000 ohm, ½ w. res.
C_1, C_{10}—100 μμfd. mica capacitor
C_2, C_3, C_4, C_5, C_6, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{15}—47 μμfd. mica capacitor
C_8—.01 μfd., 200 v. ceramic capacitor
C_7—50 μμfd. mica capacitor
Lamps 0 through 9—NE-2 neon bulb
P_1—8-prong plug
V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8—½ 12AU7 tube

Tube Testers for Speedy Checking

The two tube testers shown here check all of the popular tubes used in radio and TV sets. On the left is the B&K "Dyna-Quik," the one below is by TeleTest.

When servicing in the home, time is money; these tube testers save service time.

EVERY service technician, whether he works for himself or someone else, is always running a race with the clock. Time is truly valuable and any instrument which permits a necessary job to be done more quickly than before, without impairment of accuracy, will always be of interest to the service industry.

"Dyna-Quik" Model 500 Tester

An instrument which is designed to speed up tube testing is the "Dyna-Quik" Model 500 tester, manufactured by the *B & K Manufacturing Company* of Chicago. This instrument is portable and operates on the G_m principle. It contains 30 sockets and will test close to 400 different types of tubes. Each socket will check only the specific tubes which are listed for that socket. The test procedure is to first locate the proper socket for a tube. At the bottom of the instrument panel there are two controls, labeled "Heater" and "Sensitivity." The proper settings for these controls are indicated with each tube listing. Once the controls are set, the tube is plugged into its socket, a "Test" button is depressed and the condition of the tube is revealed on the large 4½ inch meter. The three indications are "Good," "?," and "Replace."

If desired, the exact mutual conductance value of each tube can be obtained by setting the "Sensitivity" control according to a separate chart attached to the inside of the front cover. In addition, this instrument will also reveal gassy tubes, tubes with grid-to-cathode leakage, and tubes having contaminated grids. Tube shorts, between heater and cathode, grid and cathode, grid and screen, or grid and plate, will automatically light up a neon bulb. Another automatic feature of this instrument is its line voltage regulator circuit. This maintains test voltages constant over power line variations from 105 volts to 125 volts.

An interesting feature of the Model 500 is the provision made for keeping the socket panel plate up-to-date. The designers of this instrument recognized that new tubes are appearing constantly and a tube tester must keep abreast of these changes if it is to retain its usefulness for any extended period of time. To meet this situation, a new overlay plate will be prepared whenever a significant number of new tubes has been developed. The instrument owner will then be able to obtain this plate for a nominal charge and use it to cover the original plate.

The Model 500 "Dyna-Quik" tester is specifically designed to be taken into the house where a rapid check of all receiver tubes may be made. In this respect it will not only pin-point tubes which are definitely bad, but a special life test will also reveal those tubes which are on their way to becoming defective. By calling the latter tubes to the set owner's attention, callbacks can be significantly reduced.

TeleTest T-56 Checker

Another rapid testing tube checker is the *TeleTest* T-56 instrument. This contains 60 sockets and is equipped to check a wide variety of receiving tubes as well as picture tubes and selenium rectifiers. In addition, continuity can be tested in circuits having resistance as high as 1½ to 2 megohms. If continuity exists, a neon bulb will light up. If more than 2 megohms of resistance is present (and this includes an open circuit), the bulb will remain unlit.

The manner in which the *TeleTest* Model T-56 is used for its main purpose of checking tubes is quite simple. All of the tubes which can be tested in this instrument are listed on a tube chart which is fastened to the inside of the top cover of the carrying case. The first column after the tube type contains the letter indicating the setting of the "Filament" switch. The second column contains the number of the proper test socket on the panel of the tester. The third column contains the number that indicates the section to be tested.

The fourth column has the "Reference" number or meter reading for that tube type. If a tube has only one section, there will be only one section setting and one reference number. A tube can have as many as four sections. In the event that the tube has more than one section, there will be a separate section number for each section and a separate reference number.

The reference number refers to the meter scale. This scale is divided from 0 to 100. In checking a tube, if the meter reads on or below the reference number for that tube, it can be considered faulty and should be replaced. For a tube to be considered good, the meter should read above the reference number.

Just beneath the indicating meter there are three neon bulbs. Inter-element shorts automatically light one of these bulbs prior to the test of the tube or section of the tube. Heater-to-cathode shorts are revealed by the lighting of one of the other neon bulbs. The third bulb lights up when a tube is gassy, or there is grid emission or there is less than the desired resistance between grid and cathode. (The latter is sometimes referred to as a high resistance grid short, which is obviously a misnomer, or as grid leakage.)

Either of the foregoing tube testers may be used in the home (their primary purpose) or they may be used in the shop. In the latter place it has been suggested that customers be permitted to check their own tubes, when these are brought in. It has been found (surprisingly enough) that when a customer checks the tubes himself, he is more likely to replace all those showing up bad. Whatever the psychology behind this, the service technician benefits two ways. First, he sells more tubes. Second, he does not lose 20 to 30 minutes checking tubes. —30—

Projection Color TV with a Color Wheel

By JAY STANLEY

Fig. 1. The complete projection color TV receiver showing the color converter described in the December, 1954 and January, 1955 issues in the upper compartment and the color wheel and switch in the lower. The complete 6-tube keyer chassis mounts in the cut-out section of the converter.

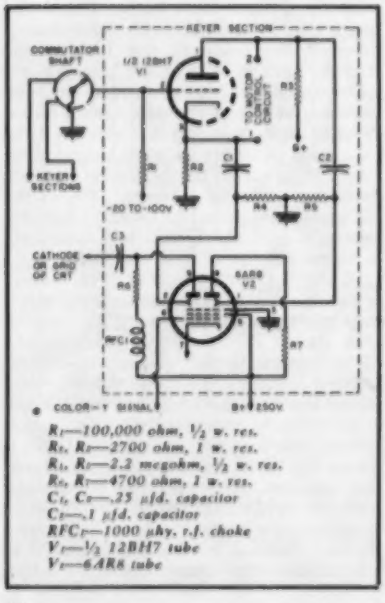
In response to requests from readers — here is how you may use a color wheel and one projection unit with the color TV converter described in the Dec. and Jan. issues.

THE original model of the color converter described in the December 1954 and January '55 issues of RADIO & TELEVISION NEWS was designed for use with a 3-unit projection system. This is by far the simplest way to get a color set going—but of course it is a somewhat cumbersome way to do the job. For this reason, many readers have asked for data on using one projection unit and obtaining the color with a color wheel.

This article outlines such a system, as shown in Fig. 1. It is *not* intended as a step-by-step construction article but, rather, will present a method that has been developed from experimental work with a color wheel system so that the experienced technician can, in working out his own layout, avoid many of the pitfalls which may otherwise plague him.

In theory, a color-wheel system is quite simple. First, there needs to be a switching system between the red, green, and blue outputs and the picture tube, so that the proper output can be switched to the picture tube at the proper time. This must coincide with the time when that section of the color wheel is in front of the tube. For example, when the color converter is delivering a red signal to the projection tube the red segment of the color wheel should be in front of the tube so that a red image is projected.

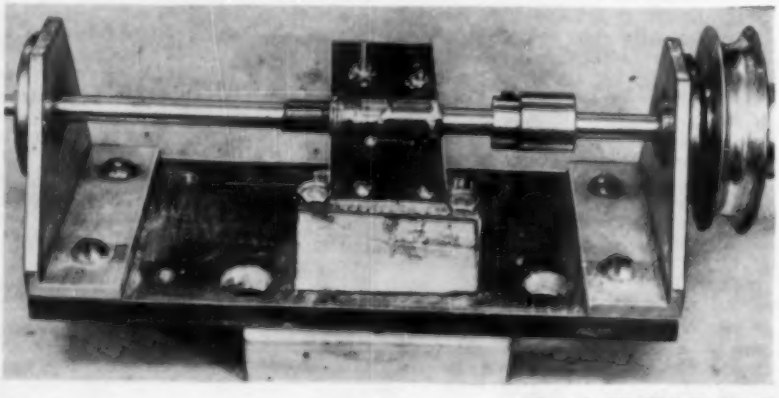
Of course, this switching action can start with a rotary switching device on the shaft of the color wheel, as shown in Fig. 3. But the difficult part of the job comes from the need to sync the color wheel so that it stays exactly in step with the vertical sync frequency of the set. This is necessary to make certain that the "crossover" point (when changing from one colo. to the other) occurs during retrace, and not



R_1—100,000 ohm, ½ w. res.
R_2, R_3—2700 ohm, 1 w. res.
R_4, R_5—2.2 megohm, ½ w. res.
R_6, R_7—4700 ohm, 1 w. res.
C_1, C_2—.25 µfd. capacitor
C_3—.1 µfd. capacitor
RFC—1000 µhy. r.f. choke
V_1—½ 12BH7 tube
V_2—6AR8 tube

← Fig. 2. Schematic diagram and parts list of one of the keyer sections used for selecting the right color signal to go with the color filter in front of the projector. Three keyers are required.

Fig. 3. Commutator-type switch on the shaft of the color wheel used for breaking the color signal into a field sequential one to operate properly with the color wheel. The switch shown here is an example of what may be used, the constructor should use his ingenuity to devise one that is precise and practicable.



during the regular scanning time. If the latter happens, a bar works up and down on the screen, much like a vertical blanking bar.

In an early model of the color-wheel system, it was decided to let the wheel run at random speed, switching the output with commutator contacts on the shaft of the color wheel. But trouble with "crossover" points and noise difficulties led to abandoning the system. However, if the bugs could be worked out, the system would be wonderfully simple in both circuitry and parts.

Subsequent work has been based on the use of a saturable reactor. The vertical sync signal is picked up from the grid of the vertical output stage (or any other convenient point in the vertical system) and applied to a phase detector, driving a d.c. amplifier which, in turn, varies the d.c. potential on a saturable reactor. The reactor controls the speed of the color-wheel motor, with the result that it keeps in sync with the vertical sweep of the TV set, so that the "crossover" occurs during the retrace when it is not visible on the screen.

As shown in Fig. 2, the switching starts with a commutator, the rotary shaft of which is grounded. The "rotating" ground is applied to the grids of three keyer amplifier tubes in turn. Each of the keyer amplifiers feeds the deflector elements of a 6AR8 tube—a wonderful new type developed especially for color work. In effect, this tube is a voltage-controlled single-pole, double-throw switch, and at the same time an amplifier.

Here is how the switching takes place. The commutator segment, as it grounds the grid of the keyer amplifier, removes the bias voltage and allows a pulse of plate current to flow. The output is taken off across R_2 in the cathode circuit and is positive with respect to ground. This positive voltage is used to switch the 6AR8 from one plate, which is idling (no output), to the plate which is driving the CRT cathode.

The color minus Y signal is fed to the control grid of each of the three 6AR8's, one for each color. As the commutator rotates, it will switch the output to the live plate of each tube in turn. The net result is a sequential color signal applied to the CRT that is in step with the segments of the color wheel. The commutator cannot be used directly for switching the inputs to the CRT as the noise level from the sliding contacts is prohibitive, and of course, with a 1 megacycle video signal present at this point, it cannot be bypassed. However, the indirect switching method outlined, makes it possible to bypass the commutator segments with a small capacitor (.001 μfd.) and get rid of the high-frequency noise, the only noise present. Even this small capacity will round the edges of the switching signals somewhat, but these are hidden in retrace anyway.

The symmetrical output from one of the keyer amplifier tubes (points 1 and 2 in Fig. 2) is applied to a shaping network to form a narrow pulse which is fed to the phase detector and compared with the vertical saw-tooth present on the grid of the vertical output tube (see Fig. 4). The resulting

(*Continued on page* 135)

R_1, R_3—100,000 ohm, ½ w. res.
R_2, R_7—470,000 ohm, ½ w. res.
R_4—1 megohm, ½ w. res.
R_5—10 megohm, ½ w. res.
R_6—68,000 ohm, ½ w. res.
C_1, C_3—.01 μfd. capacitor
C_2—.25 μfd. capacitor
C_4—.002 μfd. capacitor
C_5—.04 μfd. capacitor
C_6—4 μfd., 450 v. elec. capacitor
V_1—6AL5 tube
V_2—12AU7 tube
V_3—6CU6 tube

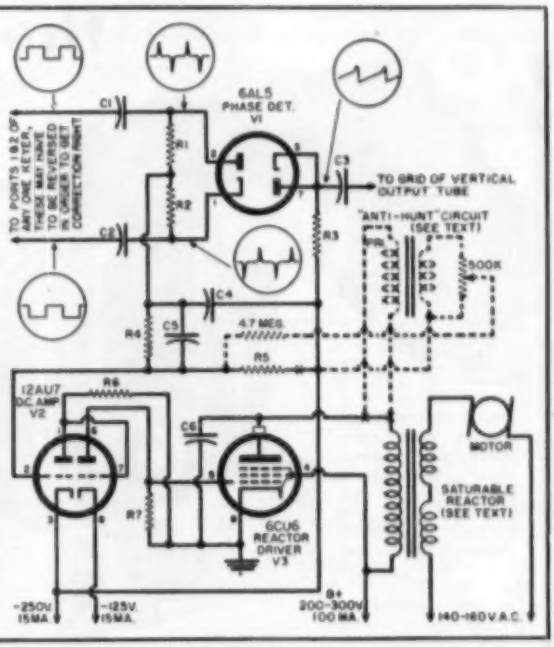


Fig. 4. Schematic diagram and parts list for the color wheel motor speed control circuit. The input is derived from one of the keyer sections, select the one that moves the bar between color wheel filters out of the picture.

Fig. 5. The four vertical output type transformers are connected as shown here to form a saturable reactor which controls the speed of the color wheel motor in conformity with the signal from the motor control circuit shown in Fig. 4.

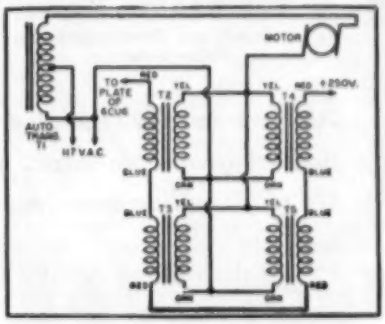
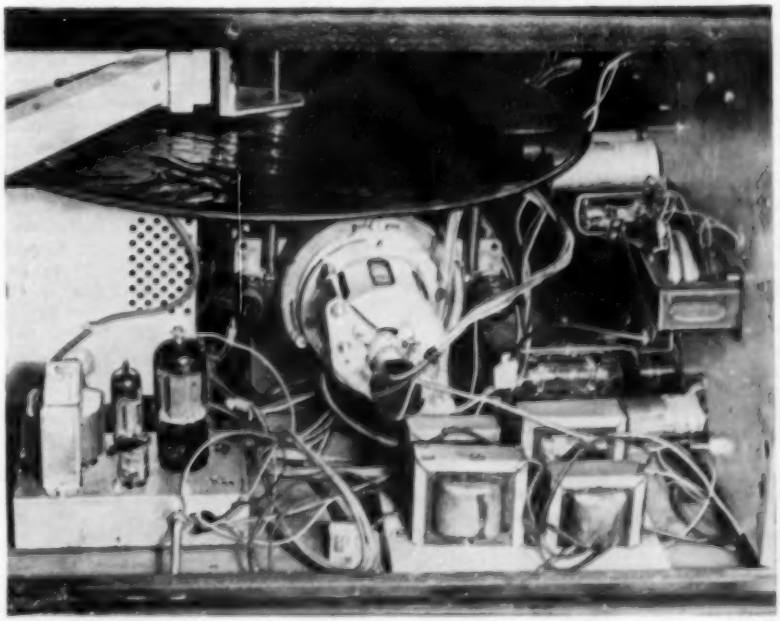


Fig. 6. View of the color wheel and associated circuitry. Note the saturable reactor and motor control chassis in the foreground. The regular deflection chassis furnished in the original Norelco projection television receiver is on the right.



the "Minipack" #1

Fig. 1. Over-all view of the electronically-regulated power supply. Although the author's unit is super-compact, it can be built on a larger chassis, if desired.

By
ROB WAGNER, W6WGD
Research and Development Lab
Dalmo-Victor Co.

An electronically-regulated power supply—delivering variable output from 75 to 175 volts, ± 1%. Up to 50 milliamperes (maximum) can be handled.

MENTION electronically-regulated power supplies to an earnest but inexperienced experimenter, and he's usually interested but often dubious because of the circuit's "complexity." Electronic supplies are *not* complex, and have many advantages over the "junker" found beneath many workbenches.

The junker consists of a transformer, rectifier, and brute-force filter, sometimes followed by a gasping VR tube, which often fails to "light" when the pack is switched to a load requiring higher current output. The VR tube supply is very satisfactory when designed to provide a single voltage at specific current requirements. What happens when the load increases? There is no regulation and a walloping voltage drop!

The electronic supply overcomes these difficulties and offers more stable regulation. The VR tube is good for approximately 3% regulation, but the electronic regulator holds the voltage steady at one per-cent or better, irrespective of load current variations. This is handy and dandy for powering the v.h.f. converter, v.f.o., or precision audio oscillator. You want exactly "X" volts d.c. for a special application? Twist the "Minipack" knob until you have the desired output voltage and you can rest assured that it'll stay put.

The "Minipack" was designed to deliver a variable potential of 75 to 175 volts d.c. at a maximum load of 50 ma. It has been of more value than a third hand around the experimental workbench, so here's why it works and how to build it.

How the Circuit Functions

As the "Minipack" was built to occupy minimum space, a circuit employing the minimum number of parts was designed. The trick is to eliminate extra filament transformers, using a single junk-box "BCL" power transformer and enough sly maneuvers to complete the job.

The schematic diagram of Fig. 2 shows how this can be accomplished. What! No filter chokes? That's correct—these circuits require less "mass" than the junkers and deliver smoother voltage to boot. Here's how:

Power transformer, T_1, delivers 350 volts each side of center tap at 70 ma. A 5Y3 rectifier tube is employed because most power transformers have a 5-volt heater winding, while rectifier tubes are cheap and plentiful. The pulsating d.c. gets partially ironed flat by C_1, the 40 μfd., 450-volt electrolytic filter capacitor. Up to here, it's a standard power supply circuit, delivering about 340 rippling direct current volts.

The "gate" tubes function as an instantaneous variable resistor in series with the output voltage. The gate can be opened or closed by varying the grid bias. The bias is derived from a small portion of the output voltage, which is amplified by the 12AX7 control tube and passed right back to the gate's control grids. Filtering, regulation, and variable output result from this closed-loop servo system, as follows:

Assume that the supply is delivering output voltage at a current drain of 40 milliamperes, when suddenly the load increases to 45 ma. The output voltage goes down, but the voltage drop is immediately amplified and applied as control grid bias to the gate. Gate bias becomes less, and the gate opens just wide enough to allow passage of sufficient supply voltage to make up the difference. If you'll visualize the time constant of this electronic jam session as almost instantaneous, you'll see why the average d.c. output remains essentially constant.

The preceding principle controls the filtering action, too. Supposing we have one volt of a.c. ripple at the output terminals. The bias proportional to one volt applies to the gate's grid, the poor little volt gets balanced out, and the net result is pure direct current. The same regulatory action also applies to line voltage variations, and the "Minipack" has the answer to line voltage grunts and groans caused by the refrigerator starting, etc.

While you're busy readying those old filter chokes for door stop and bookend service, consider how the same action allows the electronic supply to be made variable over the usable portion of its working range.

To obtain gate bias, a voltage change at the output must be amplified to the point of utility by V_{1a}, one-half of the 12AX7 control tube. By proper proportioning of the voltage divider R_5, R_6, and R_7, the correct amount of grid voltage is placed upon V_{1a} to insure its operation in the Class "A" range. This amplifier must be reasonably stable, thus its operating voltage is held constant by using PL_1 as a subminiature voltage regulator tube. Current flowing from "B+" through R_4 causes the bulb to "fire" and its 55-volt drop applies to the 12AX7's cathode as a stabilized reference voltage. (You thought we didn't like VR tubes, eh?)

The 12AX7's other section functions as a simple cathode follower, allowing

the 50B5 control grids to operate at a more positive potential. Using this gimmick, more current can be passed through the gate tubes than would be permissible under ordinary biasing conditions.

V_4's plate potential comes from the supply source through R_6, which may be from 5 to 15 megohms. The high resistance limits plate current flow to a safe value when the supply is first actuated from a cold start.

Now suppose we change the value of R_6, the output voltage control; its setting determines the operating point of V_6. By varying R_6, we control the supply's output voltage, but only within the regulatory range of the system. The output voltage is controllable from about 75 volts minimum to 175 volts maximum at 50 milliamperes, regulated within one per-cent from no load to full load. Try *that* with your VR supply. Operating with no load, read the output voltage on a test meter. With the supply running, keep an eye on the voltage reading and place a resistor equivalent to 50 ma. load current across the output. The voltmeter needle shouldn't budge a smidgin—not enough for the naked eye to see, anyhow! Again—try *that* with any ordinary power supply.

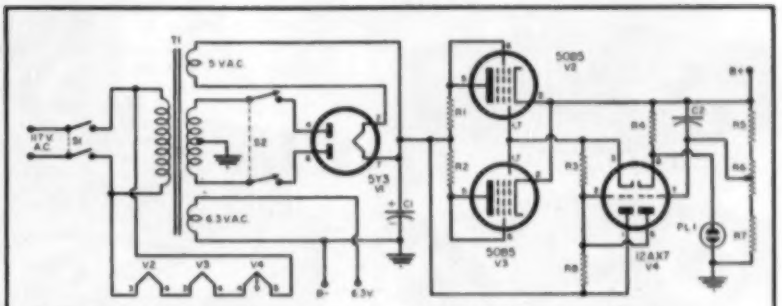
You'll find that loss of regulation occurs near the extreme range limits mentioned; this happens because the 12AX7 can swing no farther than its grid bias allows. In order to secure a lower minimum output voltage from the supply, the control tube must be furnished with a negative voltage source at the bottom of the voltage divider network. A supply designed to fulfill that requirement will be described next month.

The gate tubes are a pair of parallel-connected 50B5's, triode-connected to pass "high" current. Why these bottles? Each tube requires 50 volts of heater potential, at a fortunate current drain of 0.3 ampere. Wire the heaters in series, and it takes 100 volts at 0.3 ampere to illuminate 'em. This 100 volts being an odd figure, we put the 12-volt heater of the 12AX7 in series with the gate tube heaters. The 12AX7 heaters (fortunately) require 0.3 ampere, thus the 112-volt total requirement is met by the wall plug's output, à la table model radios. This leaves an extra 6.3 volt winding on the power transformer, which can be used to power the v.f.o. heaters.

Construction Details

The horror picture, Fig. 3, shows one method of placing three cars in a two-car garage. This results from having chosen a minimum chassis space and then being stuck with it. This type of packaging is only recommended for circus midgets or brain surgeons. On the assumption that others may be as demented as the designer, Fig. 3 illustrates that all but the kitchen sink is mounted beneath the chassis, including the 12AX7 control tube and all components other than the transformer, gate tubes, and rectifier.

The neon bulb, PL_1, serves a dual



R_1, R_2—30 ohm, ½ w. carbon res.
R_3, R_4—220,000 ohm, ½ w. carbon res.
R_5—470,000 ohm, ½ w. carbon res.
R_6—100,000 ohm carbon pot
R_7—100,000 ohm, ½ w. carbon res.
R_8—5 to 15 megohm, ½ w. carbon res. (see text)
C_1—40 μfd., 450 v. elec. capacitor
C_2—.1 μfd., 400 v. paper capacitor
PL_1—NE-2 neon bulb or equiv.
T_1—Power trans. 350-0-350 v. @ 70 ma.; 5 v. @ 2 amps; 6.3 v. @ 3 amps. (not used, see text)
S_1, S_2—D.p.s.t. toggle switch
V_1—5Y3 tube
V_2, V_3—50B5 tube V_4—12AX7 tube

Fig. 2. Schematic of "Minipak #1" power supply. By wiring the heaters in series, the filament winding on the transformer is freed to power heaters of other gear.

purpose, functioning as both VR tube and pilot light. The pilot light lets you know when the "B plus" is on, working in conjunction with switch S_2. The bulb fits snugly in a rubber grommet mounted in the chassis. See the photograph of Fig. 1.

Two power output connectors are shown. In this model, use of different cable connectors became mandatory after the pack was completed. For the benefit of non-believers, please note there was adequate room left for the second outlet long after the device had been finally completed and in operation!

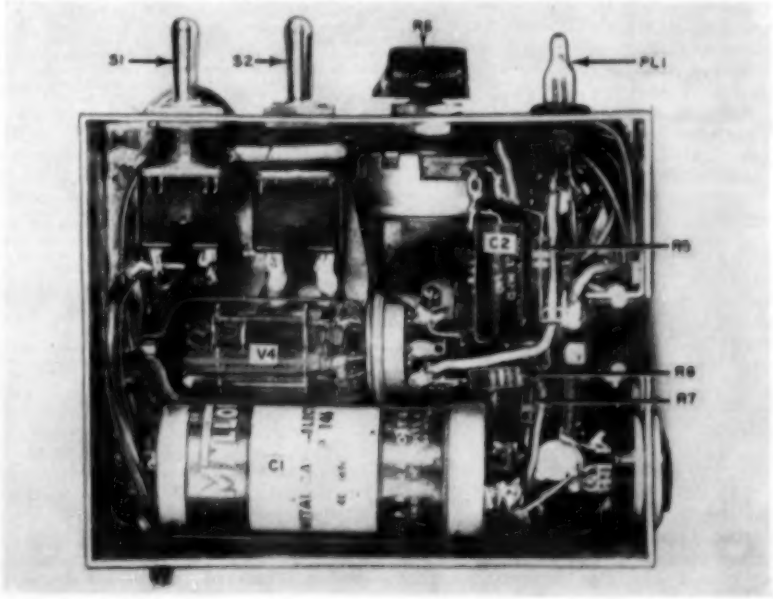
The 12AX7 fits between filter capacitor C_1 and the two power switches, S_1 and S_2. To mount the tube, remove the metal shell from a standard 9-pin noval socket, which is secured beneath the chassis by soldering its center pin to a right-angle bracket. One ground lug of the filter capacitor's outer shell is bent over and soldered to an unused pin on the 5Y3 rectifier socket. This offers a solid anchor for the capacitor, while a stiff wire connecting its positive terminal to pin #7 of the rectifier socket holds the can firmly in place.

The series-heater wiring is made with 117 volt a.c. line cord, insuring adequate insulation and keeping the price of fuses at a respectable level. There's not much remaining wiring, as all other components are soldered together where they fall.

You may not wish to develop the skill required to carve ten thousand words on the head of a pin by minimizing the "Minipack." If not, rest assured that a larger "Minipack" may be constructed according to the schematic and will perform equally well—perhaps better.

(*Continued on page* 150)

Fig. 3. Under chassis appears crowded but no operational troubles have resulted.



SINGLE SIDEBAND ROUNDUP

By ELBERT ROBBERSON

E. F. Johnson is designing a new SSB exciter. Details on this unit are not yet available. The console shown on the left is the firm's 1 kw. linear power amplifier. Although it is a general-purpose unit, it is ideally suited for use with any SSB exciter unit.

A survey of some of the new commercial equipment items now available at amateur radio distributors.

THE hottest thing to hit ham radio since the vacuum tube is single-sideband telephony. And no wonder. By concentrating transmitter power on an r.f. derivative of voice input, and leaving out everything else, single-sidebanders are able to transmit as much intelligence with a few watts as old-fashioned A-3 users manage with many more. Then, using receivers with spike response (instead of the usual many-kc. plateau) improved signal-to-noise ratio gives the effect of another power boost. This adds up to a theoretically possible 9-db gain over A-3, and there are other advantages.

There's only one trouble. Generation of SSB signals is a little complex. Although simple SSB transmitters have been built with as few as three tubes, few hams build their own. Thus transmitters are like receivers, in that professional manufacturers produce better gear for general use, and for less money, than the most experienced amateur builder.

Naturally, different concerns employ different techniques. Before making a selection, the careful amateur will examine the field. To help, here is a survey of what different companies offer to date.

A QUICK LOOK AT SSB FUNDAMENTALS

Speak into a microphone and voice-frequency alternating current is generated. But what we want is radio-frequency power, that can be fed to an antenna and radiated.

Everyone is familiar with the local oscillator and mixer used in the front end of modern receivers to change incoming signals to another frequency. By using the same principles, we can heterodyne voice-frequency current with the output of an r.f. oscillator and move the voice signal into the radio-frequency spectrum.

The signal will then consist of the following components: a sideband (or heterodyne) on the frequency of the r.f. wave plus audio frequency and one amounting to the r.f. minus the audio frequency. Between the two, the r.f. oscillator frequency will ride through.

This combination of three frequencies is the conventionally-known "carrier" and upper and lower sideband frequencies of an AM signal. And just as in superheterodyne reception, all of the intelligence is contained in one of the sidebands—both the "local oscillator" and "image" frequencies are excess. A means for removing these non-essential frequencies is the heart of the SSB transmitter.

There are two systems—the "brute force" which filters out all but the desired sideband, and the "phasing" which balances out unwanted frequencies. So many factors are involved that neither system has clear-cut superiority for amateur use.

Unfortunately, manufacturers' power-rating systems vary. To help make comparisons, here is a rule of thumb: The FCC rating is the average d.c. input power; Peak input power is 1.4 times average input; Peak output or peak envelope power approximately equals average input power; Average SSB output (two-tone test) should be .6 or .7 average input.

Barker & Williamson

The 51SB phasing type SSB generator is offered by *B & W*. This unit is designed to be inserted between the driver plate and final amplifier grid in an already-existing transmitter. This is accomplished either by breaking the driver-to-amplifier coupling circuit and installing r.f. cable connectors or by using a tube socket adapter which provides the external connections. Conversion kits for necessary modification of *Collins* 32-series transmitters and *Johnson* "Vikings" are available. Composite or home-built transmitters require special treatment, advice on which may be obtained from the factory. *B & W* also supply a companion transmitter unit to be described later.

In the 51SB, continuous-wave output from the normal transmitter v.f.o. (or crystal) and driver is modulated and phased to produce upper or lower single sideband, which is fed back to the power amplifier grid. Modulation takes place at operating frequency, and band changing is made by a panel switch. When frequencies are changed, it is of course necessary to retune the sideband generator. Main panel controls are "Audio Gain," a switchable meter, band selector, driver and balanced modulator tuning, and upper and lower sideband switch. A voice-operated relay and speaker-deactivating circuit are included.

The companion Model 5100 transmitter incorporates a v.f.o. and 150-watt input amplifier to go with the SSB generator. Coverage from 10 to 80 meters is controlled by a panel switch, and the pi-net amplifier has the regular grid, plate, and loading controls on the panel. AM and CW operation are possible and the combination can be used to excite a legal-limit amplifier.

In addition to these complete outfits, *B & W* makes plug-in audio phase-shift networks and 17- to-20 kc. toroidal-coil filters for amateurs who want to build their own.

Burnell

Another manufacturer of single-sideband filters, *Burnell and Company*, offers 47 to 50 kc. toroidal-coil sideband filters for transmitters and receivers. Application data and circuits are furnished, including procedure to

adapt any receiver having an i.f. between 200 and 1000 kc. to double-conversion operation with the 50-kc. sideband filter.

Central Electronics

Central Electronics, Inc. manufactures the "Multiphase" line of phasing-type exciters, as well as a bandswitching broadband linear amplifier; and a "Sideband Slicer" and "Q-Multiplier" as SSB receiving accessories. Two exciters are available: the Model 10B and the 20A. Both units operate either from crystals or external v.f.o.'s with 10 and 20 peak watt outputs respectively. The 10B uses plug-in coils, while the 20A has a panel bandswitch.

In both the SSB signal is generated at a frequency of 9 mc., and a mixer stage is used in the output circuit to heterodyne the 9-mc. signal into the desired band. A crystal plugged into a socket on the front panel can be used to operate on the 160-, 80- or 20-meter bands. A v.f.o. of proper range will provide operation on these frequencies and also the 40-, 11- and 10-meter bands. Commercial v.f.o. units for the purpose are obtainable, while many amateurs use modified command transmitters, for which *Central Electronics* provides conversion kits.

Fifty-two ohm output can be fed directly to an antenna or to a linear power amplifier. Panel controls provide for upper or lower sideband, AM, PM, or CW, as well as voice-operated or manual control. Besides the necessary tuning and balancing controls on the panel, the 20A has a tuning eye.

Both units are available as kits as well as in completely built and tested form. In addition to v.f.o.-conversion kits, accessories include crystal-controlled 10-meter converters, and PS-1 plug-in, pre-aligned audio phase-shift networks for receiver or transmitter builders.

Central has recently introduced a broadband bandswitching linear amplifier, the Model 600L. Using an 813 tube in Class AB_2 at 60 to 65% efficiency the amplifier has a peak power input of 500 watts. The only controls are the bandswitch and a meter switch, which reads reflected power, indicative of antenna match, as well as power input in watts, grid current, and r.f. output in amperes. A safety cut out operates in case of severe mismatch, and has a panel indicator lamp and reset button. Bandpass couplers are used in the amplifier grid and plate circuits. With broadband antennas, operation anywhere in a band can be enjoyed by just turning the v.f.o. frequency knob.

Collins

Collins Radio Co. offers a full kilowatt SSB rig for ten to eighty meters. Or, if you wish to start small, the exciter may be obtained separately.

As might be expected of the developers of a line of magnetostrictive filters, *Collins* employs the filter system of single-sideband generation. A self-excited, high-stability oscillator on either 251.5 or 248.5 kc., depending on whether lower or upper sideband is desired, feeds r.f. to a balanced modulator where audio is mixed in and the carrier removed. The desired sideband is selected by a 250-kc. mechanical filter having a passband of 3000 cycles. The resulting signal is then combined in the first mixer with r.f. from the self-contained v.f.o., which operates from 2750 to 3750 kc., giving output on the 80-meter band. Two stages of linear amplification follow, giving excitation for the two 6CL6's in the driver stage. The last stage is a blower-cooled pair of 4X150A's. To improve amplifier linearity, r.f. inverse feedback is used, from the 4X150A plate circuit back to the 6CL6 grids. Improper load and overmodulation types of distortion are prevented by an "Automatic Load Control" incorporated in the circuit of the final amplifier. Normal input is one kilowatt, at 2000 volts and 500 ma.

On bands other than 80 meters an additional mixer and crystal oscillator is used, with two additional linear amplifier stages before the drivers.

Either voice-operated or push-to-talk operation can be used, and receiver muting as well as loudspeaker feedback prevention is provided. Exciter bands are changed by panel switching, while ganged capacitors and coils in the pi-net output circuit cover the entire range.

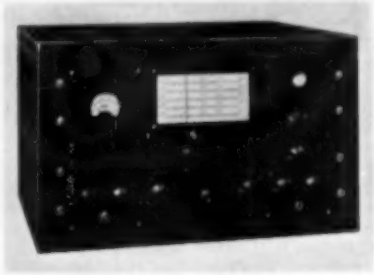
An emission-control knob switches operation from SSB to AM and CW, while internal provision is made for frequency-shift-keying oscillator connection. The AM signal is unique in that only the carrier and one 3-kc. sideband are emitted. Although ordinary broad-response receivers do not take full advantage of this system, no material AM signal difference is said to result from the transmission of only the one sideband.

A complete set of major components and accessories makes possible a number of variations on the basic unit.

Eldico

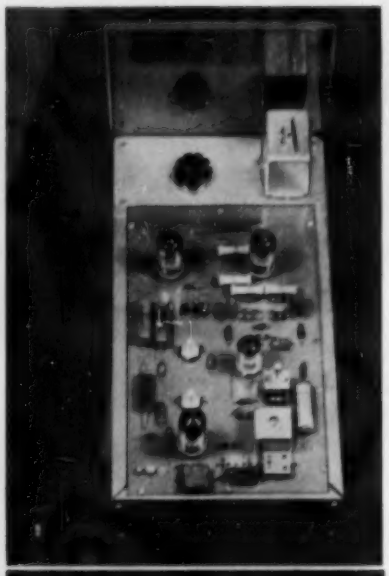
A 100-watt exciter-transmitter and separate 500- and 1000-watt input linear amplifiers are offered by *Eldico*. The SSB-100 exciter-transmitter is the phasing type with self-contained high stability v.f.o., and is completely panel controlled, giving output on all bands from 10 to 80 meters. Power output is sufficient for effective communication, or to drive amplifiers up to the legal power limit. Emission can be switched

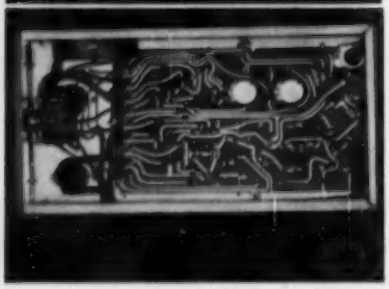
(Top) Collins' 75A-4 receiver for SSB reception and (below) its KWS-1 transmitter.



Eldico's SSB-100 exciter/transmitter unit.

(Left) B & W's Model 5100 transmitter and (above) Model 51SB single-sideband generator unit.



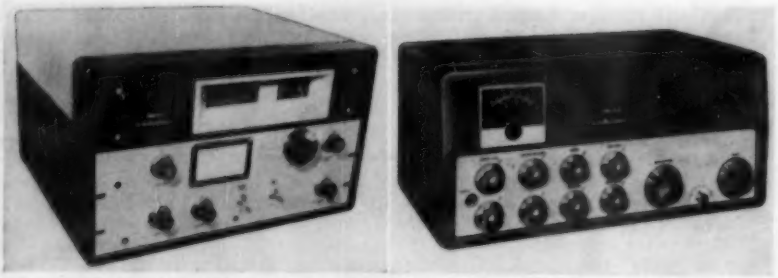


(Top) Lakeshore's "signal splitter" with jumper plug. (Bottom) Under chassis view.

from CW to AM or upper or lower sideband. All of the adjustments necessary for balance, carrier injection for AM, and tuning, up to the power amplifier, are factory set, and need not be touched in normal operation. The final amplifier uses an AX9903 in a pi-net output circuit, and panel controls are provided for grid and plate tuning and loading. Voice-operated keying, a receiver-quieting circuit, as well as a speaker-bucking provision to prevent feedback to the microphone are incorporated.

Eldico's 500-watt linear amplifier is designed to function with as little as 3 watts peak grid drive, permitting its use with any of the standard commercial exciters. Cabinets match the SSB-100 and power supplies are built in, giving a complete tabletop outfit. Panel controls for screen and grid-bias voltage give reduced power operation if desired. Turret-coil bandswitching with conventional grid and pi-net plate circuits are used.

The SSB-1000 uses a heavy-duty grounded-grid amplifier with a PL-6580 triode operating at 1000 watts average input and is intended as a companion piece to the SSB-100 exciter/transmitter. Due to the fact that the tube can dissipate much more than this amount, no power reduction is necessary when tuning. The only controls



Hallicrafters' HT-31 linear amplifier (left) and HT-30 SSB exciter (right).

are the bandswitch, plate tuning, and loading.

Eldico's SSB rigs have built-in oscilloscopes as well as meters. They also manufacture the VFO-10/20 for *Central Electronic* exciters.

Electronic Engineering Co.

The *Elenco* line includes crystal-filter exciters and transmitters, a 400-watt d.c. input linear amplifier, bandswitching mixers, plug-in coil mixers, a voice-control unit, a speaker-feedback preventer, crystal filters, and an automatic electronic antenna transmit/receive switch.

As a feature of its quartz-crystal filter used to separate the single sideband, *Elenco* guarantees SS-75 internal adjustments for three years and for life of the unit on the Model 77 transmitter.

The Model 77 transmitter is a bandswitching crystal-filter job rated at 100 watts peak envelope power. Carrier is generated by a crystal oscillator, then modulated with audio in a 6SA7 mixer stage. A crystal filter selects the sideband and rejects the carrier. The signal is converted to operating frequency by additional mixers using crystal oscillators and a self-contained v.f.o. having a 200-kc. spread. The final stage is a pair of 807's with 53-ohm output. Voice control and speaker compensating circuits are incorporated. The only panel tuning control is the power-amplifier plate, since all previous circuits are bandpass.

The PA-400 linear amplifier is a table-top, plug-in coil job, using a pair of 811A triodes operating at 400 watts d.c. input, and requiring 6 watts driving power. Power supply is self-contained. It has low-impedance input and link output, and three controls with accompanying meters for grid, plate, and antenna-link adjustment.

The combination of an SS-75 exciter, somewhat similar to the Model 77, a bandswitching mixer and a PA-400 amplifier in a 36" relay rack cabinet is the basis of the 400-T series of complete 400-watt transmitters. In this unit, circuits supply carrier for receiver front-end injection, as well as the usual voice-control relay for transmitter keying.

Gonset

The *Gonset* Model 500W r.f. power amplifier is a bandswitching job designed to give 250 to 300 watts peak envelope power with drive from any low-power SSB exciter. It will operate on 160 meters with a simple modification. Four 807 tubes are used in parallel in a pi-net circuit. Input is low impedance with resistors across the tuned circuit to vary grid drive, and for swamping to improve linearity while operating into the AB_2 region. Exciters having output swamping resistors may require their removal for best drive.

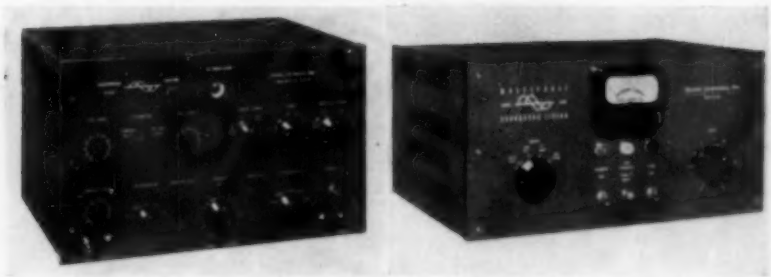
Main panel controls are the bandswitch, grid tuning, grid drive, plate tuning, and loading, which has a coarse and fine adjustment. The panel meter can be switched into the cathode of each tube for matching purposes; into the common grid-bias circuit for drive measurement; or into a two-range diode output indicator. The self-contained power supply uses four 866 Jr's or 816's in a bridge rectifier, with high-capacity filter for dynamic regulation of the equipment.

Hallicrafters

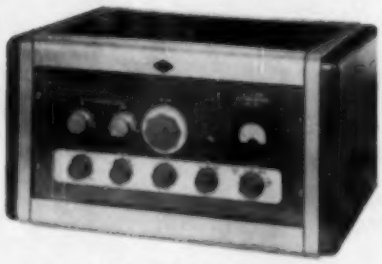
The *Hallicrafters* HT-30 is a bandswitching SSB transmitter/exciter rated at 35 watts peak envelope power from a pair of 807's. CW and AM emission are also available at the usual reduced power level. This exciter uses a 50-kc. *LC* filter to select the desired sideband. Fifty-kc. carrier from the master oscillator is further suppressed through the use of a balanced modulator. Upper or lower sideband selection is made by a panel control, switching crystals in the first mixer oscillator.

Main panel controls are the kc.-calibrated v.f.o., the bandswitch, and grid drive and plate controls for the output stage. Other controls are for speech level, carrier injection, and meter compression.

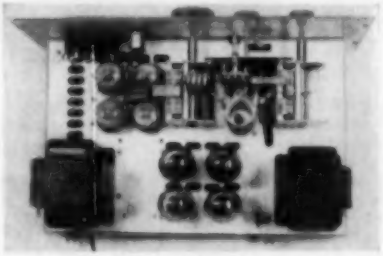
Matching the exciter is the HT-31 linear power amplifier, rated at 500 watts input, or 330 watts peak envelope power. Ten watts peak envelope power is required for drive. The amplifier consists of a pair of 811A's in a pi-net circuit. A bandswitch is used in the grid, while the plate circuit tunes continuously from 80 to 10 meters. Full output is obtainable on CW. The input is designed to be fed by a 50- to 75-ohm unbalanced line, while a pi-network output circuit accommodates loads of from 50 up to 600 ohms. A panel meter can be switched to show grid and plate current, as well as power input in watts.

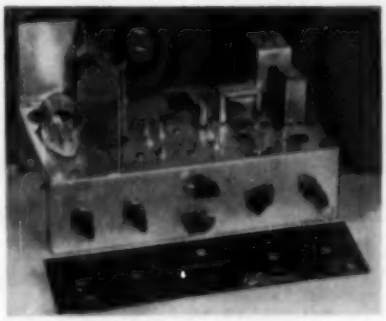


Central Electronics' Model 20-A exciter (left) and broadband linear unit (right).



Gonset's SSB amplifier (above) and top chassis view of linear amplifier (below).





Lakeshore's P-500 power amplifier (above) and "Phasemaster, Jr", a built-up kit.

Johnson

A full thousand watts on single sideband as well as CW and AM phone is the input capability of the *Johnson* "Viking Kilowatt" power amplifier. Matching desk top and three-drawer pedestal are available to make up a transmitting console. Two to 3 peak envelope watts are required for SSB excitation of the two blower-cooled 4-250A tubes. In addition to complete shielding with contact washers on control shafts, double L-section filters are used in every external lead to minimize interference.

The amplifier covers from 3.5 to 30 mc., and the pi-net output circuit works into loads from 50 to 500 ohms. A "mode" switch reduces power to 300 watts for tuning and local QSO's.

Controls are in two groups, according to use. On top are the plate and grid meters, bandswitch and grid tuning, and the slide-rule plate-tuning dial, and loading control. Plate circuit *LC* ratio is automatically adjusted for optimum "*Q*" as frequency is changed. A lower panel has a plate-voltage meter, an ignition-key type main switch, fuses, mode switch, indicator lights, and plate overload reset.

Johnson has a new SSB exciter which will be announced soon. Although the Engineering Dept. at the company would not release design details at the time of this writing, they did state that the equipment uses a different circuit approach which is claimed to provide exceptional stability and operating flexibility. The exciter, which is in the final design stages at the present time, will include a built-in v.f.o., voice-operated break-in (VOX), and many other convenience features.

Lakeshore

A line of phasing type exciters, a linear amplifier, a receiver "signal splitter," an external v.f.o., construction kits, and accessories is manufactured by *Lakeshore Industries*.

Their basic transmitter is the "Phasemaster, Jr." which comes in a mobile model as well as the conventional home-station design. Peak envelope input is rated at 60 watts.

A crystal master oscillator generates the carrier at 9 mc., which is combined with properly phased audio in a 1N34 diode balanced modulator. A second r.f. signal from an external v.f.o., or a plug-in crystal, is combined with the signal in a 6BA7 mixer stage to excite the final 807 amplifier at output frequency. This arrangement covers all bands, but with reduced power on 15 and 10 meters.

A magic eye tube on the panel provides visual indication of stage resonance and carrier null balancing. There are also controls for audio gain, upper and lower sideband, and AM, balancing, mixer, and final-amplifier tuning. A plug-in anti-trip voice control unit provides break-in voice keying of the transmitter. The equipment is furnished less power supply and can be operated from dynamotors such as the PE-103 or an equivalent a.c. source. The deluxe model comes with a dual power supply.

The P-500 is a 500-watt input class-B amplifier using a pair of 5514 tubes. A built-in transformer furnishes filament power, but no d.c. supply is included. Requirements are 1000 to 1250 volts d.c., and grid bias which may be taken from the deluxe "Phasemaster."

Tuning of both grid and plate circuits is continuous from 80 through 10 meters, without coil changes or switching. Grid drive is controlled from the front panel. A panel meter gives plate current readings.

The *Lakeshore* "Signal Splitter" for reception of upper or lower sidebands on conventional 455-kc. i.f. receivers uses printed circuits, and is available in kit or wired and tested form. This unit operates from either receiver power or a separate power supply which fits inside the "Splitter" cabinet. An accessory adapter accommodates the unit to receivers with i.f.'s of 50, 85, 100, and 915 kc.

A "Band Hopper" v.f.o., giving all-band operation when heterodyned against a 9-mc. SSB signal, features a potted oscillator circuit for stability. The power supply and voltage regulator are built in.

Special SSB components are offered for the home builder. Matched diodes, modulation transformers, r.f. coils and a.f. phase shift networks, carrier balancing potentiometers, voice-control relays, crystals, and variable capacitors are also available from the same manufacturer.

Millen

James Millen, Inc. manufactures ninety-degree audio phase-shift networks for both receivers and transmitters. Precision resistors are used, and factory adjustment need not be touched. The 75012 gives 90° differential shift ± 1.3 degrees over the range of 225 to 2750 cycles.

Transitron

A table-top 500-watt linear amplifier with self-contained power supply is offered by *Transitron, Inc.* It features a continuously-tuned grid circuit and bandswitching pi-net output to feed a 50- to 75-ohm load. Amplifier operation is adjustable from class A to C.

In conclusion, the mere use of one circuit or another is not as important as the integrity of the manufacturer. Past experience with a concern, and personal examination of their gear tell the story. But whatever your tastes and operating budget, there is now a single-sideband outfit to match. –30–

By BERT WHYTE

A FEW months ago I let off some steam about the menace of the so-called audio discount houses. With a subject as controversial as that, I expected to get quite a number of letters, both pro and con—and I did. What floored me though, was the large number of readers who really tore into me, in defense of the discount practice! To be quite frank, I was rather taken aback by some of these tirades, until I examined these letters more carefully and then the big light dawned! You see, when one lives in New York, you are at the "hub of the universe" as far as high fidelity is concerned and this sometimes leads one to forget that the U. S. is a very big place and there are faithful followers of the hi and the fi in every nook and cranny of all the 48! The discount situation I was so worked-up about, is far different than the one for which I was taken to task in those letters. In short, the discount practices which I wrote about are largely a New York phenomenon, with offshoots in Chicago and other big city centers.

Let me explain. Back in the very early days of high fidelity, about the only places that handled hi-fi equipment were the radio parts jobbers. To the average person these were formidable establishments, for not only were the windows full of intricate and intimidating electronic gear, but there was usually displayed in a most conspicuous place a big sign which read *"Wholesale Only."* The sign referred to the fact that radio technicians could buy in these establishments at prices which were generally 40 per-cent off manufacturer's list. If the person in search of equipment was fortunate enough to get by the wholesale requirement, he enjoyed that fat discount. If the parts jobber was adamant (and most were) the customer had to deal with the service shop and pay the full list.

It was a pretty stultifying situation and had it remained so, hi-fi would still be in swaddling clothes. However, probably because the average radio service shop did not have the money necessary to stock hi-fi equipment, they never became a big factor in the business. What happened was that some of the parts jobbers let down the bars, and as soon as it became known among the local enthusiasts that they could get the discount, their volume convinced the dealers that hi-fi was worth pursuing as a going business.

The thing that really broke the dam and started hi-fi on its amazing sweep of the country was the big mail order houses. All of them, *Allied Radio, Concord-Lafayette, Newark*, etc. printed catalogues by the hundreds of thousands in which they offered all hi-fi equipment at 40 per-cent off the list. Faced with this competition, most of the local parts jobbers saw the light, gave up the wholesale baloney and installed regular hi-fi departments. While a few held out, for the most part the victory was complete. The manufacturers of hi-fi equipment dropped the "fiction" of the list price and there was established what is known today as "audiophile net." It must be said, however, that a few manufacturers have such widely diversified lines which embrace both audio and "radio parts," that they have kept a list price on their equipment. It is now evident to me from some of the letters I have received that in certain sections of the country some "johnny-come-lately" dealers are trying to extract the full list price from the unknowing audiophile. Since it is virtually impossible to become a hi-fi enthusiast without eventually getting "hep" to the pricing situation, most people soon know whether or not they have been "taken" by a slick dealer.

Small wonder then, that I received some irate letters from people who thought I was defending the "list price" artists! Nothing could be further from my mind! I thought the hi-fi price structure was so well known and widely disseminated that when I talked about discounts, I would not be stepping on anybody's toes. Please believe me, I think anybody who has paid a *manufacturer's list price* for audio equipment has literally been robbed! The discount houses and the practices that I was referring to are the organizations which *cut the audiophile net price.*

A legitimate hi-fi dealer works on what is considered a relatively small margin of profit in most retail businesses. This is generally 33⅓ per-cent *gross* profit. Out of that profit, the dealer must maintain well-equipped and expertly staffed showrooms, a representative stock, service, repair, and delivery facilities, etc., etc. The good hi-fi dealer gives freely of his advice and time and you are afforded services which would be unheard of and be considered ridiculous in other businesses. Yessir, in most hi-fi salons you get a fair shake . . . you get your money's worth and then some! Now let's face facts . . . If you are offered equipment for 10 to 20 per-cent off the *audiophile net price*, that means the shop you are dealing with is only making from 13 to 23 per-cent profit. You don't have to be a CPA to know that an organization which has to offer the kind of services which are a necessary adjunct of the hi-fi business, cannot survive on such low profits. Obviously, if a dealer does offer these discounts, something has got to be missing and that "something" is the personalized attention and service which are a *must* in the sale of hi-fi equipment. It also follows that even with the elimination of the services, the discounter must do a volume business to keep his head above water.

As I said in the previous article, if you're a hi-fi expert, and you know exactly what you want, and know how to install and service your equipment, then there is some justification in going to a discount house. (Although, I've seen a lot of "experts" get really *stung*.) Since the vast majority of people are not experts they have to rely on the integrity of the shop they are dealing with to guide them in selecting hi-fi components. In a discounter's shop this has no validity . . . there the credo is *sell, sell* anything at all to keep up the volume, no matter if the equipment is not what the buyer wants or needs at all! Therein lies the danger to high fidelity.

Many people who were sold what was purported to be a hi-fi music system, are saddled with equipment that won't work, or is imbalanced and on which they can't get any service. Is it any wonder these people are soured on high fidelity? And remember this . . . word of mouth may be the best advertising, but it is also a devastatingly effective way of ruining a business. Ten people sour on hi-fi can tell 50 of their friends about their raw deal, and the 50 friends will pass on the word to 100 of their friends . . . and so on *ad infinitum*. Yes, the manufacturer's list price was and is a fiction and I sincerely hope no one will get clipped by this device. And just as sincerely, I insist that anyone who cuts the audiophile net price cannot properly sell and service hi-fi equipment. I hope I have made myself clear to those who thought I was encouraging "list price" buying.

Since this is the last issue before the New York Audio Fair, I want to invite any of you who plan to attend the show, to visit the RADIO & TELEVISION NEWS exhibit, which this year will have a most interesting and unusual display. I can usually be reached there when I'm not floating around the show, and I will try to answer any questions you might have about records or equipment.

Equipment used this month: *ElectroSonic* professional arm and cartridge, *H. H. Scott* strobe turntable, *Marantz* audio consolette, *Fairchild* 50-watt amplifier, *Jensen* "Imperial" and *National* catenoid speakers.

RAVEL
DAPHNIS AND CHLOE
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG 50048. RIAA curve. Price $6.35.

This is the second complete "Daphnis and Chloe" to appear on LP and I think it is fairly safe to say that in view of the quality of this edition and the previous Ansermet reading, no record company will be imprudent enough to issue another version for a long time to come. I don't quite know where to begin with the review of this recording. I've listened to it in its entirety four times now, and have discovered new riches with each hearing. Yes, this recording is *that* good, one of the small group of LP's in the catalogue which can be considered outstanding. This has everything you would want in a recording . . . an authoritative and spine-tingling performance, a virtuoso orchestra at the top of its form, and some of the most incredibly realistic sound ever engraved on a disc! I probably should admit that my enthusiasm for this recording is somewhat of a reflection of my fondness for this fabulous score. Of all the wonderful things Ravel wrote, this is undoubtedly his masterpiece.

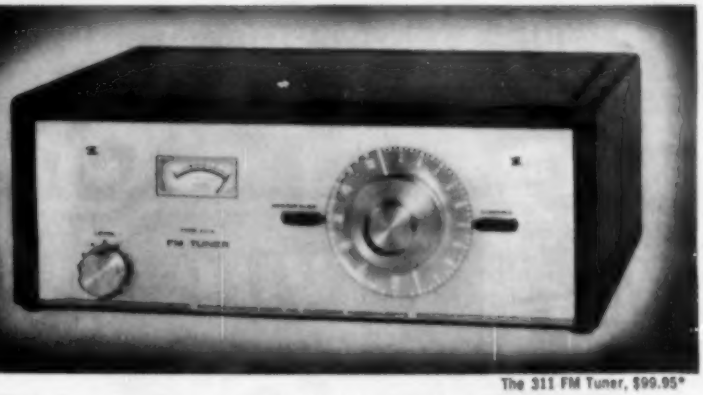
For those of you who are familiar with the music only through the two suites usually heard in the concert hall, this will be a

(*Continued on page* 144)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

by h.h. Scott

Sensational FM Performance at a Best-buy Price



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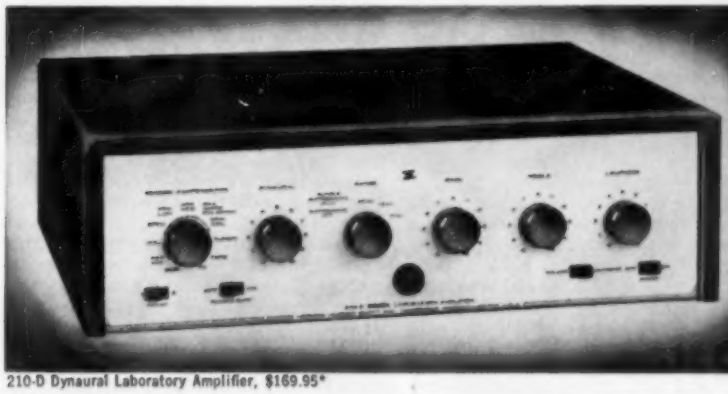

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By JOHN T. FRYE

THE TECHNICIAN AND PROGRESS

BARNEY dawdled on his way to work with the lagging step of a reluctant schoolboy—and what a glorious morning it was for dawdling! Not the smallest cloud marred the inverted azure bowl of the October sky. The lawns, still green because of early fall rains, sported only an occasional fallen leaf to accent their dewy emerald beauty. Trees along the street showed just the faintest copper sheen to hint at the gorgeous color that would soon be theirs, and the air that brushed Barney's freckled cheek was fresh and cool and sweet.

Somehow, on such a morning, it seemed exactly right that he should find Mac, his employer, chuckling jovially to himself inside the service shop.

"What's so funny?" Barney asked with a grin of anticipation.

"Well, I just had a sharp reminder that you can't be a smart aleck and a good businessman at the same time," Mac confessed. "Remember those two radios that fell off the tailgate of the semi-trailer as the driver was backing into a loading dock and that were crushed beneath the wheels? You'll recall the trucking company brought them over to see if perhaps we could salvage one good set out of the two, but a quick check showed this was hopeless. Anyway, both sets were still lying on the service bench when an early customer brought in his receiver. Since Matilda is on vacation, he came on back to the service department and started giving me the set's symptoms. Right in the middle of his recital his eye lighted on those two clobbered sets, and he asked what happened to them. I couldn't resist the temptation to explain airily that they were just a couple of radios that gave me a hard time and made me lose my temper; and then I waved significantly at the five-pound sledge on the floor beneath the bench. You know, I had a heck of a time persuading that guy to leave his set with me; and I'm still not sure I convinced him I was kidding! From now on, I'll confine my joking to after-business hours."

Barney walked over to the bench, highly pleased that the nearly-infallible Mac was admitting to error, and picked up the book his boss had tossed aside as he started relating his experience with the customer.

"'*Atomic Radiation Detection and Measurement* by Harold S. Renne,'" Barney read off the cover. "How come you're going in for this stuff? Isn't it sort of off-trail for a radio and TV technician?"

"Not any more," Mac denied. "Electronics and atomic energy are moving closer together every day, and it takes a real hair-splitter right now to say where one leaves off and the other begins. People expect us to know something about nuclear energy. Almost every day someone pops a question at me that I can't answer about Geiger counters, how the atomic sub works, or what is the effect of atomic radiation. The fact this book is published by Howard W. Sams, who specializes in publishing data for service technicians, proves he considers the subject important to us. And I know the kids who read the comics and the science-fiction magazines consider me a real square because I can't answer their questions about how many roentgens of exposure they're getting from their fluorescent watch dials, etc."

"From the looks of this table of contents you ought to be an authority after you read the book," Barney commented as he went on to read aloud: "'Atomic Structure, Atomic Radiation and Its Effects, Commercial Geiger Counters, Scintillation Counters, Dosimeters, Home-Built Counters, Civil Defense, Prospecting, Applications of Nuclear Science.' Looks like you get quite a dose of both theory and practice. When you get through with the book, I'd like to read it. Maybe I'll build me a Geiger counter."

"You'll certainly be welcome," Mac promised; "and don't overlook the Manufacturer's Directory, Product Directory, and Bibliography in the back when you start collecting parts or want to pursue the subject still further."

"You know," Barney reflected, "life's really getting difficult for us service technicians. It's not enough that we have to read and study like mad just to keep up with the new developments in the radios and TV sets we work on. Oh no; in addition, we're supposed to keep abreast of the very latest in color TV, nuclear energy, transistors, printed circuits, and goodness knows what all else. And these related fields do not hold still, either. Almost every day sees new developments in them. Color TV sets are undergoing a much-needed simplification process; transistors are coming on the market with power outputs measured in watts instead of milliwatts; entirely new techniques are being developed in printed circuits. Sometimes I wish everything would just stand still for a year or so and let me catch up."

"I know exactly how you feel," Mac said sympathetically; "and there's a lot of difference between knowing some theory of a subject and in knowing that subject well enough to service equipment connected with it, as we must do. I often think really smart manufacturers would do everything possible to make their new products easy to service. The good-will this would generate with service technicians would be passed along to customers and promote much quicker acceptance of the new device. When new equipment is hard to service or is introduced without sufficient service information preceding it, it is launched under a decided handicap.

"I remember when one car manufacturer introduced his first V-8 motor the mechanics promptly gave it a black eye because it was hard to service and required special tools. They complained you even had to jack up the motor to remove the oil pan! Garagemen knocked this car so consistently and thoroughly that the public was slow to accept it. Another example is the wristwatch. At first jewelers disliked these because of their small and intricate works. The watch repairmen gave their customers the impression that these despised wristwatches were not practical timepieces and that buying one was a poor investment. It is only in the past few years that this prejudice has been largely overcome."

"What do you think the TV manufacturers could do to make things easier?"

"One simple thing would be to color code or indicate in some other easy-to-see manner the important check points in a chassis. Where to introduce the sweep signal, where to connect the scope for viewing the video i.f. curve, where to connect the scope for discriminator alignment—these, and all other important points that are usually indicated on a diagram as 'A,' 'B,' 'C,' etc., should be plainly marked. It is a great nuisance to have to trace out the circuit and see exactly where 'the junction of R_{13}, R_{11}, and C_{28}' is. Marking this important junction point with a dab of color or a little tag would save the technician valuable time and

(*Continued on page 188*)

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A High-Voltage Transistor Power Supply

By
ROBERT W. CHAMBERS
and
L. G. COLEMAN

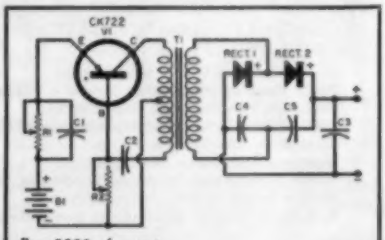
A compact unit which can be used to power Geiger or scintillation counters.

WHEN the April 1955 issue of this magazine appeared on the newsstands the authors had just completed the construction of their own scintillation counters. Since the major problem we had encountered was that of a high-voltage power supply, we were interested in the types shown in the schematics. We must confess to feeling slightly superior, and here's why.

Over the past several years many types of high-voltage, low-current power supplies have been proposed for use in portable Geiger and scintillation counters. Although some of these systems have merit, the inherent disadvantages of many are readily apparent. To list a few of these disadvantages; excessive weight, high initial cost, high operating cost, limited reliability, large volume, poor stability, and discontinuous operation.

To overcome these disadvantages the authors set about to build their own supply. After due consideration it was decided that a transistor power supply would be a welcome refinement. Circuitwise, the transistor serves in the same capacity as a vibrator in that it interrupts the current in the primary circuit. This interruption is achieved by means of an oscillator winding on the transformer. This provides cut-off

Complete schematic of the transistorized power supply. With the exception of the transformer, all parts are standard.



R_1—5000 ohm pot
R_2—1 megohm pot
C_1—50 μfd., 25 v. elec. capacitor
C_2—10 μfd., 25 v. elec. capacitor
C_3—.05 μfd., 1600 v. capacitor
C_4, C_5—.002 μfd., 1600 v. capacitor
B_1—22½ volt battery (Burgess Z30NX or equiv.)
Rect.1, Rect.2—Dry disc rectifier (International Rectifier Corp., Type U75HP)
T_1—Part #TC-673 (available from Cam-Co Engineering Co., see text)
V_1—"p-n-p" junction transistor (Raytheon CK722)

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14. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.

15. Blank pin or locating key on each tube is shown on placement chart.

16. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

17. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.

18. Series filament strings are schematically presented for quick reference.

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current for the base of the transistor. The transistor requires only a minute amount of current to provide base cut-off, whereas a vibrator, by comparison, consumes a huge amount of current merely to keep the reed vibrating. This low power requirement allows the use of a single 22½ volt battery. In fact, in our own case, a single 45 volt battery was used to provide source voltage for the scintillator. The power supply operated from the 22½ volt tap. This supply delivers 2000 volts d.c. at 20 μa. maximum with an input of 22½ volts at 10 ma. In our own case we supply a 1200 volt regulator tube with 1350 volts. This requires a power supply input of 5 ma. at 22½ volts. In a continuous 100 hour bench test, using the 22½ volt tap from a *Burgess* 5308 battery, the unregulated a.c. output from this supply dropped from 1550 volts to 1425 volts. More than enough to supply the counter.

In the field we used the 22½ volt tap of a *Burgess* Z30NX. After one week in the field at approximately 8 hours per day the battery was still going strong. The physical dimensions of the completed supply are as follows; length, 2 inches; height 2½ inches; and width, 3 inches. Weight is less than one pound.

Caution: To operate the supply, R_1 *must* be adjusted for minimum current before the supply is turned on. After the supply is turned on R_2 is adjusted for maximum output voltage and locked in place, all other adjustments for output voltage being made with R_1. Failure to follow this procedure may result in a ruined transistor. Maximum transistor ratings: 10 ma. at 22½ volts.

All electrical parts necessary to build this supply are standard, with the exception of the transformer, and are available from most electronic supply houses. The transformer may be ordered from *Cam-Co Engineering Co.*, 11449 Segrell Way, Culver City, California for $9.75 post prepaid. —30—

VIBRATO DEPTH CONTROL FOR "ELECTRONORGAN"

By K. M. HOORN

THOSE who have undertaken the construction of the "Electronorgan" from the series of articles by Richard H. Dorf (November and December 1953 and January 1954), may, like the writer, have been disturbed by the necessity for making the decision as to the "fixed amount" of vibrato depth to be built into the instrument.

How much is enough? Will it suit the accoustical conditions of the room in which the instrument is to be played? Will it satisfy the desires of the different individuals who might play the instrument?

These questions were particularly bothersome to the writer inasmuch as the instrument under construction was to be played in a "live" church building with speakers in a reverberation chamber. It was obvious therefore that some means of controlling vibrato depth without shifting frequency of the master oscillators would be highly desirable.

It was decided that the solution to the problem should be approached in three steps.

1. Determine the maximum amount of vibrato depth to be desired using the circuit shown in the articles. (A 5000-ohm potentiometer was selected)

2. Tune master oscillators to proper frequency at the voltage resulting from setting of potentiometer in Step 1.

3. Devise means of reducing vibrato depth without varying master oscillator plate voltage from value derived in Step 1.

In the writer's case the maximum depth occurred with 155 volts on the plates from the arm of the 5000-ohm potentiometer.

Several complicated arrangements were tried with little success. However, the final solution turned out to be quite simple.

A second 5000-ohm, 4-watt, linear, wirewound potentiometer was secured and ganged to the original, using surplus gears driven by an idler. The arm of the original potentiometer was set to give 155 volts on the masters using the original circuit (max. depth). The arm of the second potentiometer was set at one extreme and the arm and the end giving zero resistance then connected in series with the arm of the original potentiometer and the master oscillator load. The gears were then meshed and setscrews locked.

Counterclockwise rotation of the idler shaft now moves the arm of the original potentiometer toward the regulated d.c. source (reducing vibrato depth) while the arm of the second potentiometer moves to insert compensating resistance in series with the load to maintain master oscillator plate voltage (and frequency) at a constant value.

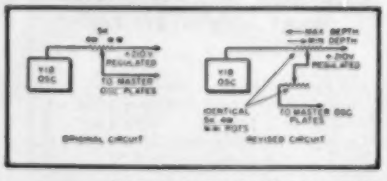
The simple device fulfilled all expectations. A check, using a borrowed precision frequency counter, on the highest frequency master (4186 cycles) revealed a maximum shift of 2 to 3 cycles over the full range of vibrato control, an amount too small to be detected by the ear.

It should be noted that the two potentiometers must be identical and linear, to obtain these results. Those used by the writer were manufactured by Centralab.

To facilitate control of vibrato by the organist the potentiometers were moved from the power supply to a blank space on the filterboard from which point a shaft could be extended to the coupler panel to provide "fingertip control." A receptacle installed on the power supply in lieu of the original control, and a cable to the filterboard completed the installation.

The device is recommended to all constructors who have encountered similar problems. —30—

A simple alteration in the original "Electronorgan" circuit permits adjustable vibrato depth control by the organist.



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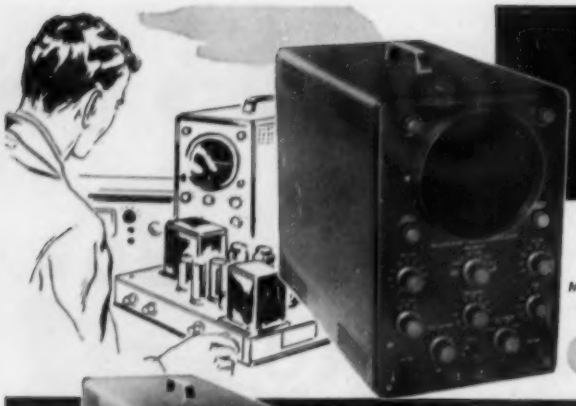

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Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

NO. 337-C
$3.50*
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5 *Heathkit* ETCHED CIRCUIT

3" OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½" H. x 6½" W. x 11¾" D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

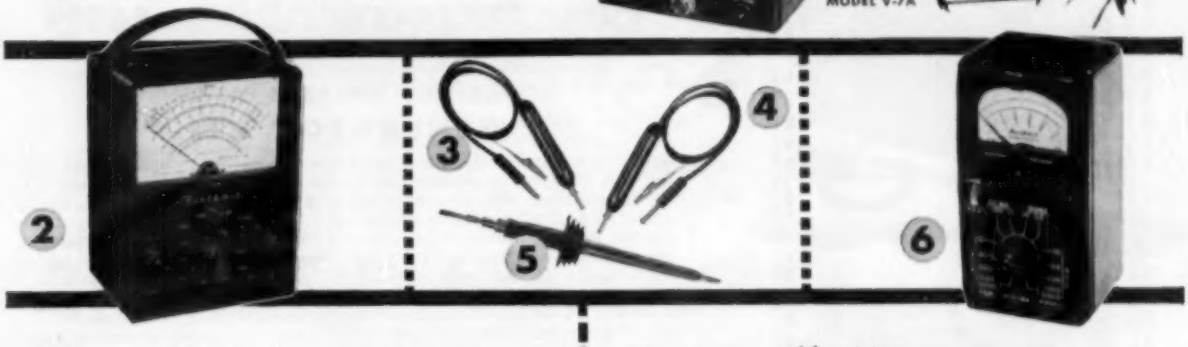
MODEL OL-1
$29.50*
Shpg. Wt. 14 lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

fill your test requirements

WITH HEATHKITS

DESIGNED FOR YOU: *Heath Company test equipment is designed for the maximum in convenience. Besides being functional, Heathkits represent the very latest in modern physical appearance, and incorporate all the latest circuit design features for comprehensive test coverage.*



1 *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A
$24.50*
Shpg. Wt. 7 Lbs.

2 *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1
$29.50*
Shpg. Wt. 6 Lbs.

3 *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C
$3.50*
Shpg. Wt. 1 Lb.

4 *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C
$5.50*
Shpg. Wt. 2 Lbs.

5 *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336
$4.50*
Shpg. Wt. 2 Lbs.

6 *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 ua. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1
$14.50*
Shpg. Wt. 3 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

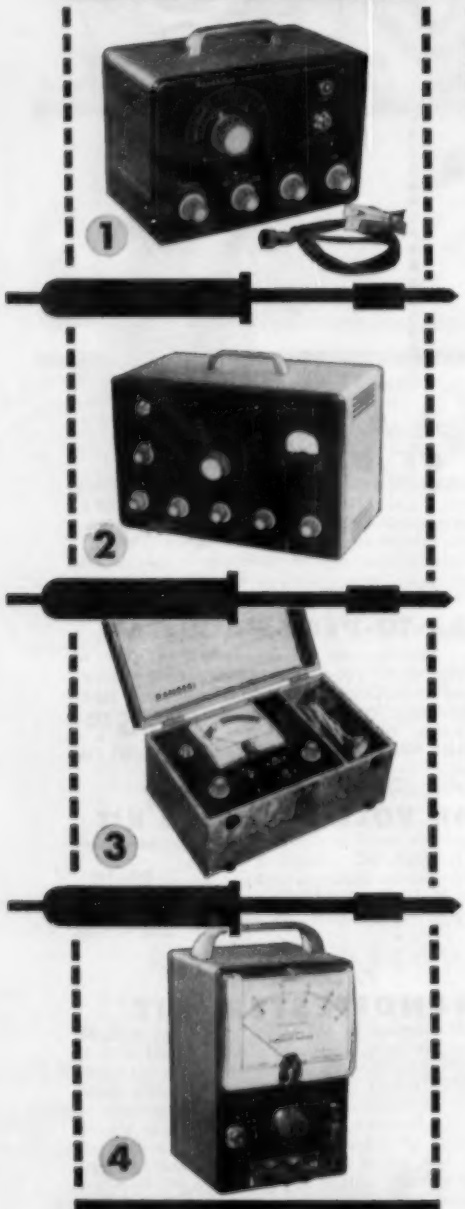
Heathkit TV ALIGNMENT GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4
$49.50
Shpg. Wt. 16 Lbs.



1 Heathkit LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1
$22.50
Shpg. Wt. 7 Lbs.

2 Heathkit LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential. It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 μv. to 1 μv. 200 μa. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1
$39.50
Shpg. Wt. 16 Lbs.

3 Heathkit CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight — ideal for outside service calls.

MODEL CC-1
$22.50
Shpg. Wt. 10 Lbs.

4 Heathkit DIRECT READING CAPACITY METER KIT

Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1
$29.50
Shpg. Wt. 7 Lbs.

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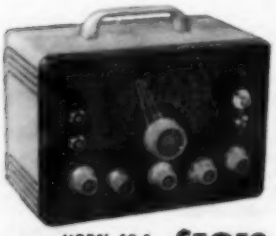
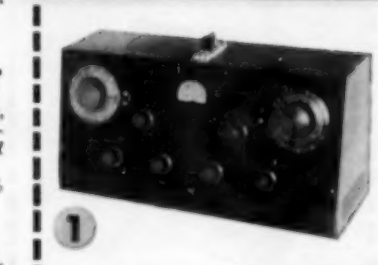


MODEL SG-8 **$19.50**
Shpg. Wt. 8 Lbs.

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

Heathkit SIGNAL GENERATOR KIT



1 Heathkit . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

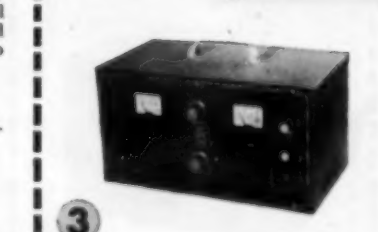
D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2 **$59.50**
Shpg. Wt. 12 Lbs.

2 Heathkit "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

MODEL QM-1 **$44.50**
Shpg. Wt. 14 Lbs.



3 Heathkit 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4 **$31.50**
Shpg. Wt. 17 Lbs.

4 Heathkit DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1 **$19.50**
Shpg. Wt. 4 Lbs.

5 Heathkit VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1 **$14.50**
Shpg. Wt. 6 Lbs.

6 Heathkit DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1 **$16.50**
Shpg. Wt. 3 Lbs.

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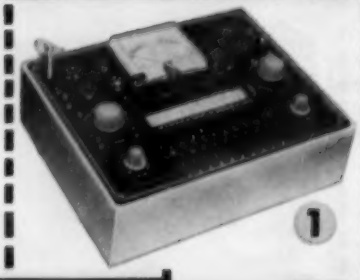
Heathkit TUBE CHECKER KIT



1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

2 Heathkit **PORTABLE TUBE CHECKER KIT**

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

3 Heathkit **TV PICTURE TUBE TEST ADAPTER**

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

4 Heathkit . . .

CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

5 Heathkit **VISUAL-AURAL**

SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

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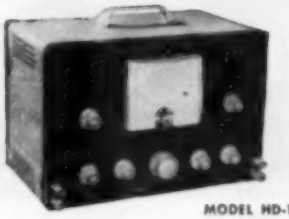
BENTON HARBOR 15, MICHIGAN

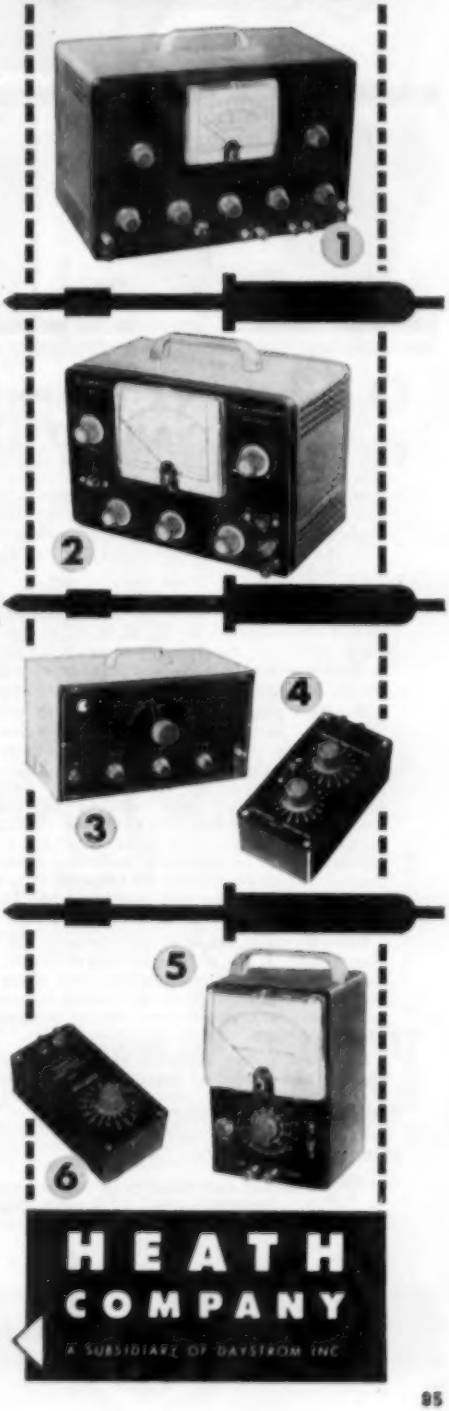


MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT



1 Heathkit AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1 **$59.50** Shpg. Wt. 13 Lbs.

2 Heathkit AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

MODEL AG-9 **$34.50** Shpg. Wt. 8 Lbs.

3 Heathkit AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1 **$24.50** Shpg. Wt. 10 Lbs.

4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1 **$5.50** Shpg. Wt. 2 Lbs.

5 Heathkit AC VACUUM TUBE VOLTMETER KIT...

The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.

6 Heathkit CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC

BENTON HARBOR 15, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost

MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*

1 *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 Lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

2 *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

3 *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

4 *Heathkit* . . . ANTENNA COUPLER KIT

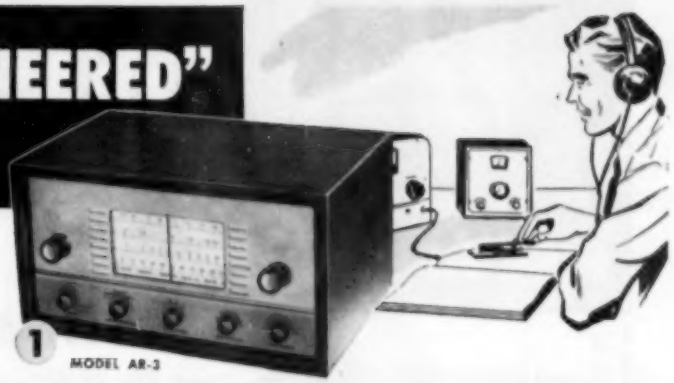
The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input→ power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

"AMATEUR-ENGINEERED"

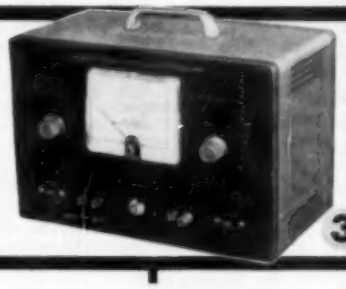
Equipment For The Ham



- MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*

1 MODEL AR-3

2



3

4

5

1 *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply–electrical bandspread–separate RF and AF gain controls–antenna trimmer–noise limiter–AGC–BFO–headphone jacks–5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-10, shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95*
Shpg. Wt. 12 Lbs.
(Less Cabinet)

2 *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

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MODEL GD-1B
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Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

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W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

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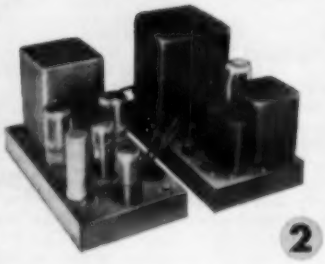


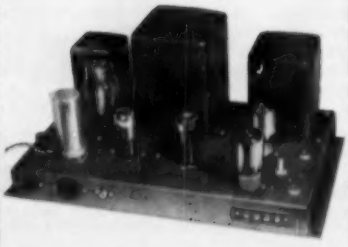
2 *Heathkit* DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**



3 *Heathkit* SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

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ATTRACTIVELY STYLED: *Heathkit high fidelity instruments are not only functional, but are most attractive in physical design. Such units as the preamplifier and the W-5 main amplifier are designed for beauty as well as performance. They blend with any room decor and are the kind of instruments you will be proud to own.*

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❶ *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

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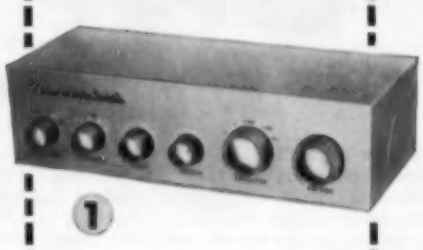
MODEL WA-P2
$19.75
Shpg. Wt. 7 Lbs.



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❷ *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
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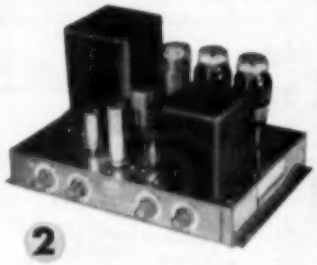
Shpg. Wt. 23 Lbs.



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❸ *Heathkit* 7-WATT AMPLIFIER KIT

The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

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MODEL A-7D
$16.95
Shpg. Wt. 10 Lbs.

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❸

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MODEL FM-3

Shpg. Wt. 7 lbs. **$24.50** (with cabinet)

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- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 μv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *pre-aligned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

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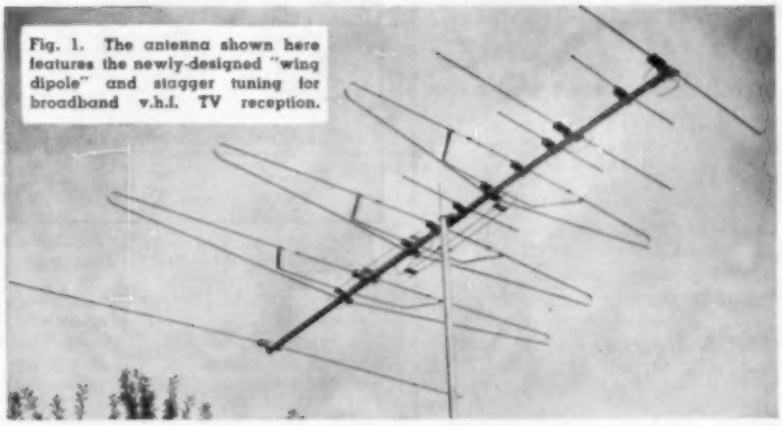


Fig. 1. The antenna shown here features the newly-designed "wing dipole" and stagger tuning for broadband v.h.f. TV reception.

Multiple Tuning in TV Antenna Design

By JOHN F. GUERNSEY
Trio Manufacturing Company

Use of a new element design in a v.h.f. yagi-type TV antenna makes possible good broadband reception.

THE problem of designing an efficient TV antenna for broadband operation is one that all antenna manufacturers have attempted to solve with varying degrees of success. In general, development work proceeded along two distinctly different lines.

All TV antennas roughly fall into two classes: nonresonant, using untuned elements, and resonant, using one or more elements cut to predetermined wavelengths. The nonresonant antenna develops a voltage at the feed-line terminals which is essentially independent of the frequencies involved. In other words, the nonresonant antenna is not a frequency selective device. Examples of nonresonant antennas are the rhombic, conical, helix, and bow-tie.

Resonant antennas develop voltages at the feed-line terminals which vary widely over a broad frequency range. The yagi antenna, one of the better-known resonant types, will develop a high signal voltage over only a comparatively narrow band. As a matter of fact, there may be a variation of several db on a 6 mc. TV channel for a multi-element, sharply tuned, yagi antenna. This is due to the fact that the active element, a half-wave dipole, is frequency selective, together with the fact that the parasitic elements also have their maximum effect over a comparatively narrow frequency range.

Fig. 2 shows the gain characteristics of a five-element yagi, consisting of a high-impedance active element together with one reflector and three directors, all elements being tuned for maximum gain on the center frequency of the channel. Broader frequency response can be obtained with some loss of gain and directivity. The dotted line in Fig. 2 shows the gain characteristics of a five-element yagi with the reflector cut for maximum gain below the resonant frequency of the dipole, and the directors resonated at a higher frequency. Such an array shows slightly decreased gain on the center frequency, but allows a frequency response practically flat over the channel.

It is not possible to obtain a sufficiently broad frequency response for multi-channel operation by merely detuning the parasitic elements in the indicated manner. Since there are two frequency ranges involved in the 12 v.h.f. channels, the problem is not precisely that of obtaining a broader frequency response, but primarily that of a broad frequency coverage on two different frequency ranges. In other words, since channels 2 to 6 cover 54 to 88 mc. and channels 7 to 13 cover 174 to 216 mc., it is necessary to provide adequate antenna characteristics on these two distinct bands. The ideal antenna should be one showing uniform gain on all channels, together with a high front-to-back ratio and a single-lobed, sharp, horizontal pattern.

It is well known that a dipole shows

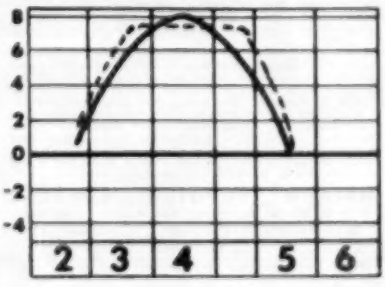


Fig. 2. Gain curves for 5-element yagis. A broadband yagi gives the flat-top curve.

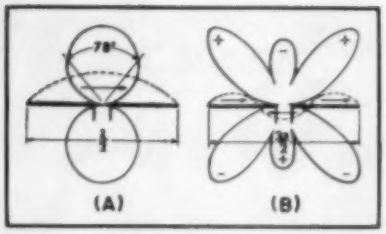


Fig. 3. Dipole patterns at (A) the fundamental and (B) the 3rd harmonic.

resonance characteristics on its harmonics as well as on the fundamental. However, the gain and horizontal pattern on the harmonics will not duplicate the situation on the fundamental. Fig. 3 shows the current distribution and horizontal pattern of a simple dipole on its fundamental and on its third harmonic. This is of special interest since the frequencies involved in the high band (channels 7 to 13) are approximately three times those on channels 2 to 6.

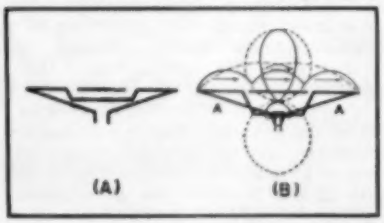
Various methods have been used to obtain an element whose current distribution on the third harmonic would provide a single-lobed, horizontal pattern. Fig. 4A shows a dipole which does this successfully. This dipole, commonly called a "wing dipole," has the horizontal pattern shown in Fig. 4B, together with the high impedance necessary for incorporating this element in an array. The current distribution on the fundamental and third harmonic is also shown in Fig. 4B.

How to use the "wing dipole" to obtain a broadband, high-gain antenna is the next problem.

This problem is very much the same as that involved in the i.f. stages of TV receivers. In the receivers, the necessity of having a flat response over a broad frequency range was solved by the use of stagger-tuned circuits. This method is well known to the TV service technician. Such a principle can be applied to antenna design. In order to cover the two frequency ranges for channels 2 through 6 and 7 through 13, with a practically flat response throughout both ranges, it is necessary to provide elements resonant on several predetermined frequencies, in exactly the same way as the stagger-tuned circuits used in TV i.f. stages.

An antenna embodying this basic idea is shown in Fig. 1. This array uses three "wing dipoles," resonated on a total of six different frequencies. This is possible since the elements are sufficiently independent as to make it practical to obtain resonance on chan-

Fig. 4. Operation of the "wing dipole."



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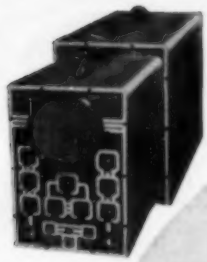

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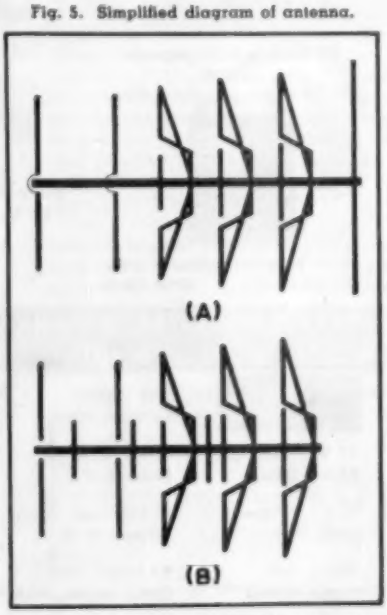
nels 2 and 7 for the longest dipole, 4 and 10 for the next, and 6 and 13 for the shortest. Each of these elements is active, that is, it is directly connected to the feed-line. The complete antenna consists of these dipoles together with the necessary parasitic elements.

There are many difficulties to be overcome in arriving at the best combination of elements for a complete array. Besides having the necessary resonant frequency, the elements of the antenna must be capable of combination in such a way as to provide the proper phase, so that the voltage on all channels will be additive at the terminals. It is also necessary that a 300-ohm impedance be maintained throughout the frequency range. In addition, the parasitic action of the undriven as well as the driven elements must provide directivity and gain on all channels. These problems are capable of solution only by intensive experimentation and theoretical design.

The operation of the antenna shown in Fig. 1 is indicated in simple form in Fig. 5. On the low channels, as shown in Fig. 5A, the array consists of three driven elements stagger-tuned to channels 2, 4, and 6, together with two directors and one reflector. Optimum phasing is provided for maximum forward gain. On channels 7 through 13, the simplified array is indicated in Fig 5B. Other than the "wing dipoles," there are seven parasitic elements. The three "wing dipoles" add a total of nine driven elements, pre-tuned to channels 7, 10, and 13, driven in-phase, together with the three directors which are an integral part of the "wing dipole." This makes a total of ten parasitic and nine active elements stagger-tuned to give flat response throughout all the low-band television channels, 7 through 13.

—30—

Fig. 5. Simplified diagram of antenna.



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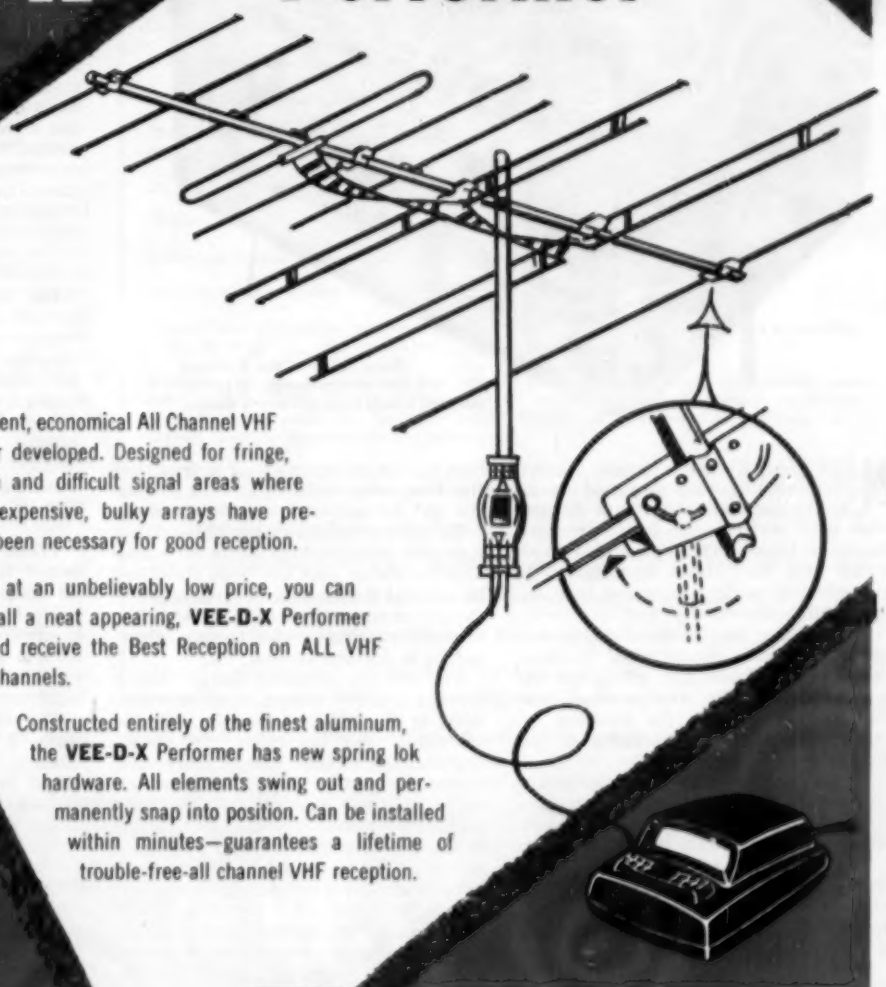

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Complete details on National's NC-300 receiver which incorporates many "most-wanted" features.

Front view of the National NC-300 ham receiver. It covers all ham bands from 160 to 1¼ meters.

NATIONAL Company's new NC-300 receiver has been designed exclusively for radio amateurs to provide good performance in the crowded amateur bands. The three characteristics that have been emphasized to provide this performance are frequency stability, sensitivity, and selectivity.

In addition to the three basic features, a number of additional features, such as provision for v.h.f. converters, provision for a crystal calibrator, and connections for external receiver control, were included in the design.

Unnecessary features, such as general frequency coverage, have been eliminated to permit improved performance in the amateur bands. The features incorporated in this receiver were those listed as "most wanted" design parameters by radio amateurs in the course of a recent company-sponsored contest.

Frequency Stability

The need for extreme frequency stability has been brought about by the increased popularity of single-sideband operation and the use of narrow bandwidths for the elimination of interference. Single-sideband operation, to be successful, requires a stability such that total drift between transmitter and receiver does not exceed 20 or 30 cps. For finding those weak c.w. signals in a crowded ham band, a bandwidth of 500 cps is provided. Such a high degree of selectivity requires that the frequency stability of the oscillator and i.f. amplifier circuits be good.

To obtain frequency stability, either a crystal-stabilized oscillator or a tunable oscillator that has been stabilized by careful design and the use of high-quality components could be used. For tunable receivers, the former alternative is not economical.

The tunable oscillator design chosen for the NC-300 guards against variations in temperature, supply voltages, vibration, and humidity. To obtain this stability against temperature variations, a stable, large fixed capacitor and a stable inductor are used in the oscillator circuit. The fixed capacitor is of accurate construction having a temperature coefficient of less than 10 parts per million per degree centigrade and a tolerance of 2 per-cent in capacitance. This special capacitor requires the use of a high grade of ceramic material imported from France. Steatite is used throughout for the insulation of the tuning capacitor and for coil forms. Those components that would be affected by humidity are sealed against vapor absorption.

To guard against the effects of supply voltage variations, careful design led to a very small voltage coefficient. In addition, in the oscillator a voltage regulator tube was used in the high voltage supply and a current regulator tube was used in the heater supply.

There have been many proponents of the Clapp oscillator circuit in the design of high-stability, variable frequency oscillators. This circuit has several advantages over the high-capacitance circuit but suffers from the disadvantage that the large inductance and the small capacitance that control the frequency are more subject to such difficulties as water absorption, dimensional changes with temperature, susceptibility to small changes in stray capacitance, and the like. It was decided that the disadvantages of the Clapp circuit made it unsuitable for use in the NC-300.

Noise Figure

For the frequencies covered by the NC-300, it was not necessary to use a triode input stage, such as the cascode, to achieve a low noise figure. Laboratory tests showed that the 6BZ6 pentode r.f. amplifier in the NC-300 yields a low noise figure as a result of the careful design of the input transformer. Typical results are 4 db at 20 meters and 5 db at 10 meters.

Selectivity

Three different conditions determined the design values of the overall bandwidth. For interference-free reception of c.w. signals, a 500 cps bandwidth was included. To provide for the inherent instabilities in transmitters in the v.h.f. region, an 8 kc. bandwidth was included.

The narrow bandwidth is obtained by using a low, final intermediate frequency. A frequency of 80 kc. was found to be the best choice to obtain a large rejection of the secondary image plus the three degrees of selectivity.

The high primary image rejection is obtained by using a first intermediate frequency of 2.215 mc. The interstage network that is used at this frequency includes a trap to reject the image at 2.375 mc. Also included in the network between the first and second mixers is a crystal filter that has adjustable selectivity. A phasing control is provided for nulling out undesired carriers and exalting the desired carriers. It has been found that neither the crystal filter nor the three values of i.f. selectivity is sufficient alone.

Provision has been made for the use of three v.h.f. converters for the 6, 2, and 1¼ meter bands. Three calibrated scales are provided on the dial of the NC-300 to operate with the

companion converters. On these three bands the receiver actually tunes from 30 to 35 mc. to act as a tunable intermediate frequency amplifier. The inherent stability of the receiver, together with the stability obtainable from the crystal-controlled converters, leads to excellent over-all stability.

To allow for minor instabilities of transmitters in this range, the 8 kc. bandwidth is provided for the i.f. amplifier. The three crystal-controlled converters use a cascode input circuit for minimum noise figure. In addition, they have a pentode i.f. amplifier, a pentode mixer, and a triode-pentode oscillator multiplier.

To aid in picking out that small signal crowded down among many others, a 40-to-1 ratio is used in the tuning mechanism. Inertia tuning is provided by the heavy tuning knob and combination pinch and gear drive.

A socket is provided for plugging in a crystal calibrator. In addition an accessory socket facilitates the use of v.h.f. converters and other accessory equipment. By means of this accessory socket, power is available for converters without the necessity for individual power supplies. In addition, provision is made for the remote control of r.f. gain. This is accomplished through a control lead in the accessory socket. Terminals are provided on the back of the receiver for muting the receiver for c.w. break-in operation. The standby switch uses a spare set of contacts that are made available on the rear of the receiver to actuate transmitter.

Two types of detectors are provided. A dual-diode provides for linear diode detection and series noise limiting on AM reception. For c.w. or single-sideband operation a self-oscillating 6BE6 is operated as a linear mixer, yielding a zero-cps intermediate frequency, or a linearly detected output. For such operation the a.g.c. voltage is developed by the diode detector. Therefore, a.g.c. can be effective for this type of operation, and an "S" meter indication is provided. -30-

SPECIFICATIONS AND FEATURES

Noise figure of 3-6 db on all amateur bands.

Ten dial scales covering 160 m. (1.8-2 mc.), 80 m. (3.5-4 mc.), 40 m. (7-7.3 mc.), 20 m. (14-14.4 mc.), 15 m. (21-21.5 mc.), 11 m. (26.5-27.5 mc.), 10 m. (28-29.7 mc.), 6 m. (49.5-54.5 mc.), 2 m. (143.5-148.5 mc.), and 1¼ m. (220-225 mc.). The 6, 2, and 1¼ m. bands require accessory converters.

Slide rule dial over a foot long. Readable to 2 kc. without interpolation up to 21.5 mc.

Three-position i.f. selectivity control on front panel. .5 kc., 3.5 kc., 8 kc. at 6 db down, enables selection of optimum bandwidth for c.w., phone, phone net, and v.h.f. operation.

Separate linear detector for SSB. Decreases distortion by allowing a.v.c. "on" with single sideband. Will not block with r.f. gain full open.

High-speed, smooth inertia tuning dial with 40 to 1 ratio.

Optional r.f. gain provision for best c.w. results allows independent control of i.f. gain.

Giant, easy-to-read "S" meter.

Provides external control of r.f. gain automatically during transmitting periods.

Has muting provision for c.w. break-in operation.

Calibration reset adjustable from front panel to provide exact frequency setting.

Dual conversion with better than 50 db primary image rejection on all amateur bands, plus better than 60 db secondary image rejection.

Crystal filter with phasing control and 3-position bandwidth control.

Wide-range tone control for both low- and high-frequency ends of response curve.

Socket for crystal calibrator plus accessory socket for power converters, etc.

First i.f. of 2215 kc. and second i.f. of 80 kc.

Crystal filter at 2215 kc. provides notching plus three bandwidth positions in addition to the three i.f. selectivity positions.

Fourteen controls: r.f. gain and a.c. "on-off"; a.f. gain and r.f. tube gain switch; tone control; AM-CW-SSB accessory switch; CW "on-off" pitch; main tuning; calibration correct; crystal calibrator "on-off"; "on-off" limiter; i.f. selectivity; crystal selectivity; crystal phasing; bandswitch; and phone-jack.

Ten tubes plus 4H4-C current regulator, 5Y3 rectifier, and 0B2 voltage regulator: 6BZ6 (r.f.), 6BA7 (1st mixer), 6AH6 (1st osc.), 6BE6 (2nd mixer), 6BJ6 (1st i.f.), 6BJ6 (2nd i.f.), 6AL5 (ANL and detector), 6BE6 (CWO/SSB detector); 12AT7 (1st audio and "S" meter amplifier), and 6AQ5 (audio output).

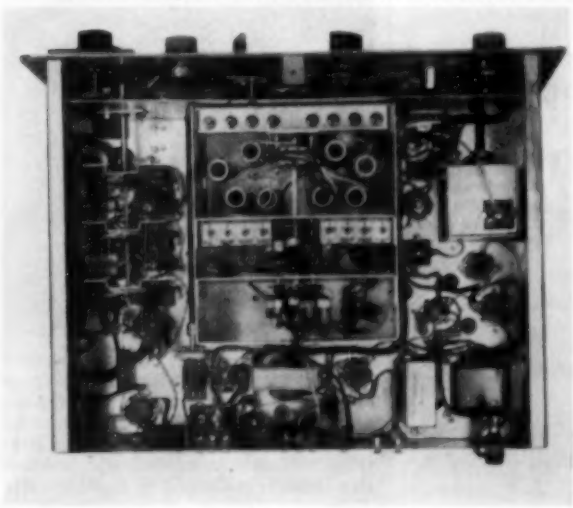
Power consumption is 60 watts. Receiver operates from 110-120 volts, 60 cycle a.c.

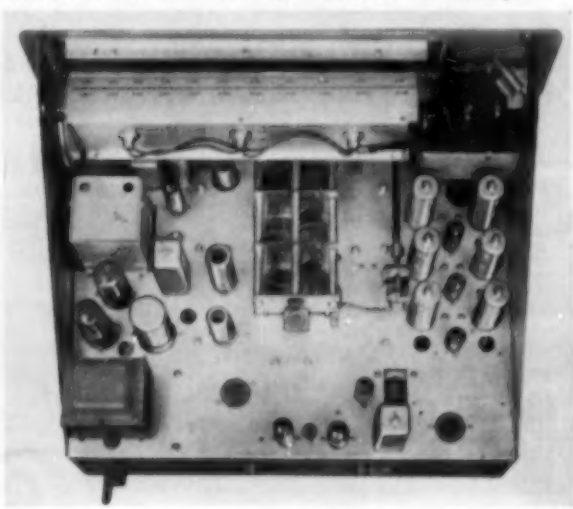
Antenna input impedance is 50-300 ohms. Output impedance is 8 ohms.

Frequency response is 200 to 3000 cycles for communications purposes.

Housed in two-tone gray enamel finish. Measures 19½" wide, 11¼" high, and 15" deep.

Bottom and top chassis views of the National NC-300 amateur receiver. Careful oscillator design insures receiver stability.





New Hi-Fi-Audio Equipment

TAPE RECORDER

V-M Corporation of Benton Harbor, Michigan had added the Model 700 to its line of tape recorders.

The new recorder is a dual-track model which can be used as a p.a. system as well as serving as a pickup from radio, TV, phonograph, or any other sound source. The unit incorporates a precision tape index timer, dual speaker system, "record ready" light, automatic shut-off, monitor switch, pause button, multi-purpose dual input jacks, dual output jacks, and a professional-quality microphone.

Other features include 7½ and 3¾ ips tape speed control, volume level control, individual bass and treble controls, and a record "safety" switch. The recorder is housed in a two-tone gray case measuring 9½" x 11½" x 16".

SYLVANIA PHONO LINE

Sylvania Electric Products Inc. has introduced two new phonograph units which feature "surround sound with a multi-dimensional effect."

Both models, one a table set and the other a console, are equipped with a woofer and two 4" tweeters. The larger speaker is front mounted. Audio-engineered doors direct the music around the room to create the feeling that the sound is surrounding the listener. Frequency response is 40 to 20,000 cps.

The record changer in the sets is equipped to play all three speeds. The pickup has a flip-over crystal cartridge with two sapphire-tipped styli. The console with a 10-watt amplifier has been designated as the Model 969 while the table model is the 919.

AUDIO POWER AMPLIFIER

Tung-Sol Electric Inc., Newark 4, New Jersey has developed a new audio power amplifier which is specifically designed for car radio service. The new tube, the 12AB5, is intended to be used either singly or in push-pull for the power output stage.

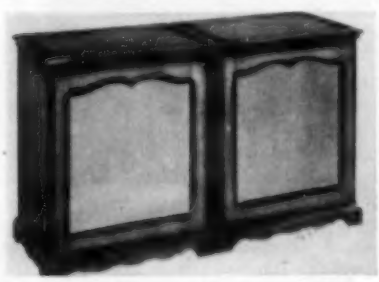
The design and ratings are directed toward use in the 12-volt automotive systems adopted by every large automobile manufacturer. Using the nine-pin all glass miniature envelope, the 12AB5 is said to provide a wider margin of safety than previously available with the smaller seven-pin types.

EQUIPMENT CABINETS

Standard Wood Products Corp., 47 West 63rd Street, New York 23, New York is now offering two matching cabinets to house audio equipment and the associated speaker or speakers.

The Model 200A acoustic cabinet features the company's exclusive "Concentri-Vent" construction (damped concentric vented reflex) for smooth low-frequency response down to 30 cps, a rigid T-brace assembly, and Kimsul acoustic padding.

The Model 200E equipment enclosure has a universal mounting arrangement



to accommodate any combination of electronic equipment, and a modern open design for ventilation and convection cooling.

Both enclosures are constructed of ¾" select-grain stock. They are available in either fruitwood or mahogany, provincial or modern styling. Each cabinet measures 30" high, 24" wide, and 17½" deep.

For full details on these and other cabinets in the company's line, write to George Entin, sales manager, in care of the firm.

TEST RECORDS AND TAPES

Robins Industries Corp., 41-08 Bell Boulevard, Bayside 61, New York has added several new items to its "Dubbings" test products line.

Among the offerings is the D-110 test tape for 7½ ips (5" reel) and the D-111 for 15 ips (7" reel). Included in the test tapes are head azimuth alignment signals, timing signals, and tests

of frequency response, signal-to-noise ratio, and flutter and wow. The D-100 test record tests the over-all performance of record players and their audio systems including frequency response, rumble, hum, flutter, wow, stylus compliance, etc. The D-101 record tests record player equalization. Both of the records are 12" vinyl LP. A fifth item in the new series is the D-500 test level indicator, a simple, low-cost device for making audio voltage measurements.

All of the products are supplied with complete instructions for proper application.

HOME STEREO SYSTEM

Ampex Corporation, 934 Charter Street, Redwood City, California has unveiled its stereophonic music system for home use. The system is based on the company's Model 612 tape phonograph.

For stereophonic reproduction, the Model 612 plays each of two separately recorded sound tracks from a single tape through two separate amplifier-loudspeaker systems. Thus, music originating on the left side of an orchestra is reproduced through the left-hand loudspeaker and music from the

right of the orchestra is played through the right-hand speaker. The result is a sense of direction and depth on the part of the listener.

The new tape phonograph can also reproduce standard tape recordings whether recorded at home or made commercially. Accommodation is provided for both full-track and half-track tapes. The Model 612 comes without audio amplifiers or speakers so that it can be connected into existing high-fidelity systems. An additional amplifier and speaker must be provided if stereophonic sound is to be reproduced.

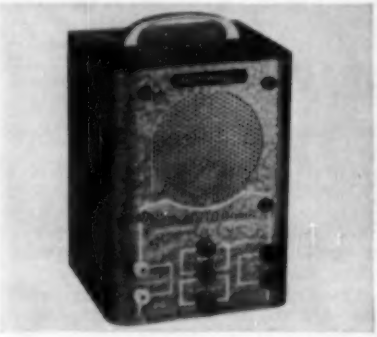
UNIVERSAL TEST SPEAKER

Dunwell Manufacturing Company of Carlstadt, New Jersey is currently offering a new, portable, low-priced universal test speaker with specially designed test leads.

The Model A6 has been designed to permit service technicians to make fast, simple audio tests on any television or radio receiver or phonograph. It can be used either in a customer's home or at the service bench, saving the time and effort ordinarily required

in removing and re-installing the original speaker.

Tip jacks connect to the sturdy 4" PM speaker, universal output transformer, 60 ohm field, and 90 ohm field.



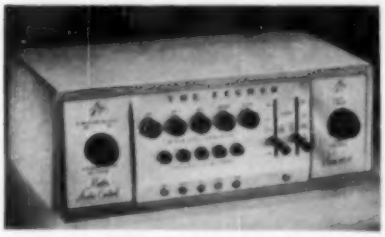
The test leads will fit every type of male or female speaker connection.

The speaker is housed in a grey hammertone cabinet which weighs just 6 pounds.

FISHER CONTROL UNIT

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, New York is now marketing a new "Master Audio Control," the Series 80-C.

Although the new unit includes features normally found only in professional studio consoles, it is designed for simplicity of operation. The "professional" features of this unit include complete mixing and fading facilities for from two to five channels, tape input to operate directly from the tape playback head, sixteen combinations of phono equalization, and accurately-calibrated loudness balance control, push-button channel selectors which, in addition to selecting the audio input channels, also operate the a.c. power to auxiliary equipment, and individual channel indicator pilot lights.



The Series 80-C is available with or without a cabinet. Mahogany or blonde enclosures are available at a nominal charge. The company will supply full specifications on this unit upon written request.

AUDIOM LOUDSPEAKERS

Rockbar Corporation, 215 East 37th Street, New York 16, New York is handling the U. S. distribution of the new *Goodmans* line of "Audiom" loudspeakers.

Designed especially for p.a. or industrial applications, electronic organs, or as bass reproducers for 2- or 3-way high-fidelity speaker system, the new line comes in 50, 25, 20, and 15-watt models.

To afford the utmost exactness in meeting specific use requirements, many of the units are available in a choice of different resonant frequencies. Two are provided with simple means whereby the user can interchange cones. In this way a cone may be selected to provide a fundamental resonance which most closely matches the application need.

For complete specifications on this new line, write the U. S. distributor.

RECORDER MICROPHONE

American Microphone Company, 370 South Fair Oaks Avenue, Pasadena, California is now offering a new series of low-cost, high-quality tape recorder microphones to the trade.

These microphones, which are suitable for paging systems and general purpose work as well as tape recording, are small in size ($3\frac{1}{4}$"x$2\frac{1}{8}$"x$1\frac{5}{16}$"), light in weight (2 oz.), rugged, and high in performance. They are available with either shielded crystal or ceramic elements.

The crystal type has a response of 100 to 7000 cycles and an output of −55 db. The ceramic type's response is from 100 to 6000 cycles with an output

of −62 db. The impedance is high in both types. They are omnidirectional and are available in either grey or beige.

UTAH SPEAKER LINE

Utah Radio Products Co., Inc., 1123 East Franklin Street, Huntington, Indiana is now offering a new, complete line of single cone and coaxial speakers which has been designated as the "Fabulous G Series."

Available in 8", 12", and 15" sizes in the single-cone models and in 12" and 15" sizes in the coaxial models, the series features heavy Alnico V magnets, spring clip solderless terminals, rugged seamless cones, and a mar-resistant finish over heavy cadmium plating.

Complete descriptive material on this new line is available from the company or from all local *Utah* representatives.

RECORD PROTECTION

Beyland Engineering Company, P.O. Box 53, Yalesville, Conn., is now offering a new liquid product which helps to keep records clean and properly lubricated.

Tradenamed "Quiet," the new product prevents static build-up and minimizes pops and ticks in microgroove records. Static, needle hiss, and sur-

face noises are stopped, record life is extended, and better record tone is obtained, according to the company.

The product comes in kit form which includes a 5 ounce bottle of the liquid, an applicator, case, and needle brush. One bottle will treat both sides of 200 ten-inch records.

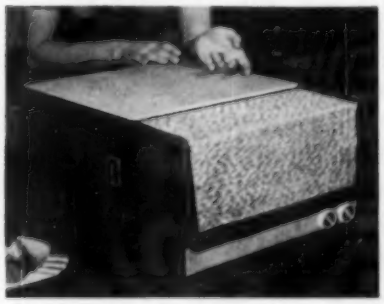
National distribution is being handled through *Ercona Corp.*, 551 Fifth Ave., New York, N. Y. Full details are available either from the manufacturer or the distributor.

NEW CRESCENT PLAYER

One of the featured units in the *Crescent Industries, Inc.* line of phono players is the Model A644.

This portable automatic phonograph is housed in a Riviera and Sky Blue leatherette trimmed all-wood case. The instrument features two speakers, a three-speed "intermix" changer, separate volume and variable tone controls, as well as an automatic "last record" shut-off.

For full details on the Model A644



and other instruments in the current line, write the company at 5900 W. Touhy, Chicago 31, Illinois.

GENERAL RADIO Z-Y BRIDGE

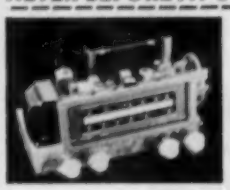
General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts is now offering a new audio-frequency impedance measurement instrument, the Type 1603-A "Z-Y" bridge.

The bridge can be balanced for any impedance connected to its terminals. From short circuit to open circuit, real or imaginary, positive or negative, a bridge balance can be obtained with ease. The nominal accuracy of the bridge is 1 per-cent over the frequency range from 20 cycles to 20 kc. The bridge reads directly the resistive and

(*Continued on page* 106)

McGEE OFFERS $100,000 STOCK OF CUSTOM RADIO CHASSIS

NEVER BEFORE AT SUCH LOW PRICES! EVEN SAVE ON COAXIAL SPEAKERS AND RECORD CHANGERS



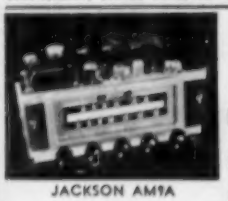
HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER

BOTH FOR **$44.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

10 W. AMP.

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 5 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased, we will include the necessary pre-amp, no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 2—6BA6, 6AT6, 6AL5 and 6X4 rectifier. Amp has 2—6V6's, 6SN7 and rectifier. Full superhet circuit with AVC, 3 position tone control, 2" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone control, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. FAS-3CR tuner and amplifier complete. Ship. wt. 23 lbs. Sale price, $44.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.



JACKSON AM9A

9-TUBE HI-FIDELITY

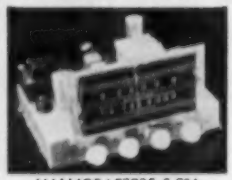
12 Watts Audio
Dual Tone Controls

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 2.2 or 8 ohm speaker. Heavy duty 165 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 540 to 1650 kc. Size, 13" x 9½" x 6" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 6Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 19 lbs. Sale price, $39.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

11-TUBE FM-AM HALLICRAFTERS



HALLICRAFTERS S-78A

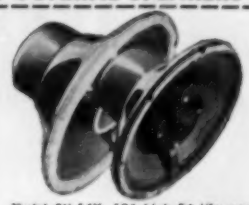
Regular $89.50
McGEE'S SALE PRICE **$69.95** LESS SPEAKER

★ HIGH FIDELITY

★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom chassis. Size 23½" x 13½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 2.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 15 watt transformer powered chassis with push-pull 6M6 audio. This chassis is found in $400 radio combinations. Has input for crystal phono pickup. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.

S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price . . . $69.95
CU-14Y, 12" COAX SPEAKER $10.00 EXTRA. 15" COAX SPEAKER $20.00 EXTRA.



McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y Sale price $12.95 each, two for $25.00.

Model P15-CR 15" high fidelity coaxial PM speaker. Response down to 20 cps, and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 8" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.

WEBCOR 3 SPEED CHANGER WITH RPX-050 G. E. CARTRIDGE

$29.95

114-43, Webcor 3 speed automatic record changer with G.E. RPX-050 variable reluctance cartridge. Plays all 3 speeds and all 3 sizes. Shuts off after last record. Has neutral position to prevent damaging drive wheels. Size, 13½" x 12".
Ship. wt. 12 lbs. Sale price $29.95

REGULAR $65.00 LIST COLLARO 3 SPEED HI-FI CHANGER

Imported from England

Sale Price **$38.95** Less Cartridge

Regular $65.00 list Collaro Model 3/532, 3 speed automatic record changer made in England. Intermixes 10" and 12" records of the same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and Std. records. Plug-in head will hold any popular cartridge. 14¾" long, 13½" wide and 4¾" above motor board, 2¾" below. Available in grey, cream and gold hammertone finish. Ship. wt. 20 lbs. Regular net, $48.79. Special sale price, $38.95, less cartridge. Large 45 RPM spindle $3.30 extra. 3/352 Collaro changer with G.E. RPX-052A "Golden Treasure" cartridge, $58.95.

ENGLISH GARRARD CHANGERS

RC-80 WITH GE RPX052A **$68.51**

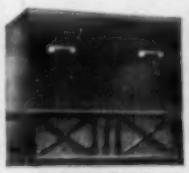
RC-80 Garrard, 3 speed automatic record changer. Shuts off after last record. Heavy 4 pole AC motor and weighted turntable gives constant speed. Muting switch silences pickup during change cycle. Separate plug-in head to fit all cartridges. 13¼" wide, 15½" deep and 8" high. 2½" below motor board. Net price, less cartridge, $58.51, with flip-over crystal cartridge, $52.46, with G.E. RPX-052A "Golden Treasure" cartridge, $68.51. 45 RPM spindle $3.43 extra.

RC-90 w. GE RPX052A **$88.11**

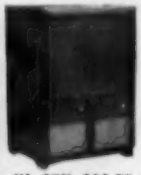
RC-90 Garrard "Crown" 3 speed automatic record changer. All of the features of the RC-80 plus adjustable speed control to regulate speed faster or slower on all 3 speed settings. Has manual position for playing single records. Separate plug-in heads to fit all cartridges. 15½" long, 13½" wide, 8¼" above motor board, 3⅝" below. Finished in cream and brown. Ship. wt. 19 lbs. Net price, $68.11, less cartridge, with flip-over crystal cartridge, $72.06, with G.E. RPX-052A "Golden Treasure" cartridge, $88.11. 45 RPM spindle $3.43

TELEVISION CONSOLE CABINETS AT LESS THAN FACTORY COST!

FOR YOUR TV CHASSIS—MODELS FOR 27 INCH TO 16 INCH CHASSIS



RT-21MA $49.95



KL-27X $39.95

$59.95

$59.95

21" MAHOGANY ½ DOOR TV-PHONO CABINET $49.95

RT-21MA, Mahogany Television-Phono combination cabinet with half doors, for 20" and 21" TV chassis and record changer. 36½" high, 39½" wide and 22" deep. Baffle cut for 12" speaker. TV compartment 21½" high, 21½" wide and 19" deep will hold most 20" and 21" chassis. Changer shelf 15" x 16" with 5" height clearance. Ship. wt. 75 lbs. Sale price, only $49.95. 21" gold trim plastic safety shield and mask to fit cabinet, $6.95 extra.

24"-27" MAHOGANY TV CABINET $39.95

Large mahogany open face cabinet for 27" or 24" television chassis. 44" high, 30½" wide and 24½" deep. Will hold a TV chassis 29" high, 29" wide and 23½" deep. Offered at a fraction of the manufacturer's cost. Limited quantity available. Has room for 8" or 10" speaker. This cabinet and other TV cabinets listed might also be converted to a high fidelity speaker baffle. Stock No. KL-27X. Ship. wt. 90 lbs. Sale price $39.95. Blank front panel available at $6.00 extra.

27" Mahogany Full Door Cab. $59.95

(a) No. 27-MA, Mahogany with full doors for 21", 24" and 27" TV, 43" h, 39½" w, 22" deep. Chassis area 27½" w, 25" h, 18½" deep. Baffle cut for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

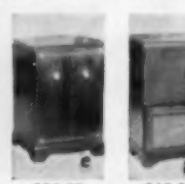
27" ¾ Door Mahogany Cab. $59.95

(b) No. 27-34MA, Mahogany with ¾ doors for 21", 24" and 27" sets, 43" h, 31½" w, 22½" deep. Chassis area 27½" w, 26½" h, 21" deep. Baffle cut for 10" speakers. Made for one of America's largest TV builders. Cost over $100. Ship. wt. 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

6-TUBE, 2-BAND RADIO KIT $14.95

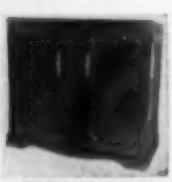
6-18 MC 550-1650 KC

6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular circuits used by colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 3 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Cabinet 13" x 8½" x 6½". Ship. wt. 13 lbs. Model MBG-2. Net $14.95.



$29.95

$19.95



NRT-21M $59.95

BT-210 $22.95

17" FULL DOOR $29.95

Fig. (e) No. AH-430, Mahogany with full doors. 36" h, 24" w, 21½" deep. Chassis area 22" w, 17½" h, 18½" deep. Blank panel. Holds 17" TV easily. Baffle cut for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price, $29.95.

17" with PHONO DRAWER $19.95

Fig. (g) SE-31, 17" mahogany TV cabinet with phono drawer 40" h, 24" w, 18½" deep. Blank panel. TV chassis area 19" h., 20½" w. Changer drawer 10½" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price, $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M, Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22½ deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½ wide and 18" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 85 lbs. Sale price, $22.95.
No. WT-210, walnut 21" TV cabinet, same as above, Sale price, $19.95.
No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

3-SPEED AMPLIFIED PLAYER KIT $10.95

2 TUBE AMPLIFIER—8" SPEAKER

Now, 3 speed amplified record player kit for only $10.95. Leatherette covered cabinet 9½" x 12" x 18½" high. Wired 2 tube amplifier with separate tone and volume controls, 70L7 and 7E5 tubes. Heavy 8" speaker, all-play pickup, motor and turntable. Cabinet is pre-cut, no holes to drill. Just fasten parts in cabinet. Only a few minutes required to assemble. Complete with simple, easy to follow instructions and all necessary items to build this 3 speed record player. Buy this player kit at less than the cost of the parts. Ship. wt. 15 lbs. Model No. RP-763K. Sale price, $10.95.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER.
BAL. SENT C.O.D.

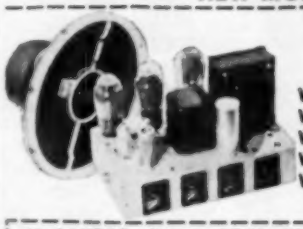
TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

NEW MODEL HF-20-20 WATT HI-FI AMPLIFIER—NOW ONLY $22.95

20 WATT HI-FI AMPLIFIER—SALE PRICE $22.95

RESPONSE 30-15,000 CPS—PUSH PULL 6L6 OUTPUT—TWIN TONE CONTROLS
INPUTS FOR MIKE AND CRYSTAL OR V.R. PHONO PICKUP



With CU-14Y, 12" Coax Speaker.....$32.95
With P15-CR, 15" Coax Speaker.....$42.95
With Imperial IV Speaker System.....$39.95
With SP-12125 CR Speaker System.....$44.95
With HF-33GE Speaker System.....$69.95
(Add $7.00 for HF-30 instead of HF-20)

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7½" x 10½" x 7½" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, $22.95.

This amplifier is recommended for use with the speaker systems described below, as well as the 12" and 15" coaxial PM speakers shown on the opposite page. HF-20 amplifier with CU-14Y, 12" coaxial PM speaker, $32.95; with P15-CR, 15" coaxial PM speaker, $42.95; with Imperial IV speaker system, $39.95; with SP-12125CR speaker system, $44.95; with HF-33GE speaker system, $69.95. If the HF-30 amplifier is desired, add $7.00 to the above combination prices.

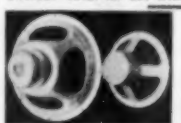
Model HF-30. Same as HF-20 with Heavy Output Trans. Rated at 30 Watts Power Output. Response 30-15,000 CPS. Ship. Weight 20 lbs. Sale Price.....$29.95
Astatic JT-30 Xtal Mike and Desk Stand $9.97 Extra

25 WATT HI-FI SPEAKER SYSTEM

2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE $24.95

25 watt, High-Fidelity Dynamic Speaker System, complete with 3000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply for only $24.95. Frequency response 30 to 16,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 2000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125HCR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.
No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.95. Ideal for use with HF-20 and HF-30 amplifiers described above.



HIGH FIDELITY SPEAKERS

8" BLUE STREAK.....$ 6.95
15" BLUE STREAK WOOFER.....$16.95

Model HF-8J, 8" "Blue Streak," Hi Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,000 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt. 6 lbs. Model HF-8J. Sale price, $6.95.
Model HF-15 J, 15" "Blue Streak," HiFi woofer. Has a 14½ oz. Alnico V magnet with curvelinear one piece cone and 1½" 8 ohm voice coil. Will give good response from 30 to 9500 cps. Ship. wt. 12 lbs. Sale price, $16.95.

2000 CYCLE L-C NETWORK $4.95 EXTRA—MODEL 4401 UNIVERSITY TWEETER $14.70

Model CR-2000, 2000 cycle L-C type crossover network. Regular $9.95 net, only $4.95 extra when purchased with either of the "Blue Streak" speakers and the Model 4401 University tweeter.
University Model 4401 single tweeter. Frequency response 2000 to 15,000 cps. Ideal for use with "Blue Streak" woofer and CR-2000 cross over network. Net price $14.70.

FAMOUS STANDARD COIL CASCODE TUNERS

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many serviceman replace all older tuners with this cascode model. Available with either 2¾" or 4½" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.
No. TV-4001-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.
Matching knobs for Standard Coil tuners. Set No. SCK-2 for one tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.

SALE PRICE $12.95
2 FOR $25.00

UHF CONVERTER TUNERS $2.95
3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory inducta-tuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH13 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice, $2.95 each, 3 for $7.50.

TELEVISION BOOSTER CLEARANCE SALE

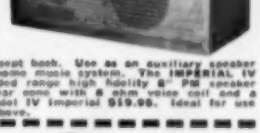
Clearance sale on VHF television boosters for channels 2 through 13. RMS Model SP-5, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascode front end. Sale price.....$4.95
RMS Model SP-6, brown plastic case. Same as SP-5 except has variable gain control. (Pictured.) Sale price.....$4.95
McMurdo-Silver GS-68 continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price.....$5.95
Standard Coil S-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price.....$6.95

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.

Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 3 wires lead the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering.) 32" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE. Sale price, $49.98.
Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $64.95. (Specify cabinet finish.)
Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University bore type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

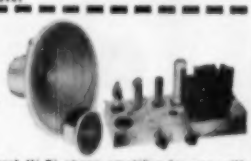
NEW IMPERIAL IV with General Electric 8 in. HIGH FIDELITY SPEAKER



$19.95

New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any hi-fi amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 80 to 15,000 cps. Model IV Imperial $19.95. Ideal for use with HF-20 and HF-30 amplifiers described above.

LOW COST 8 WATT HI-FI PHONO AMP



Push-Pull Output. Thordarson Hi-Fi Output Trans. 12" Woofer and 5" Tweeter.
McGee's
Sale Price.....

$19.95

Another outstanding McGee value. 8 watt low cost Hi-Fi phono amplifier for use with any crystal phono pickup. Approx. 1 volt input gives 8 watts audio. Features push-pull 35C5 output and 12AX7 tubes. 12" dynamic woofer and 5" dynamic tweeter. Voltage doubler power supply gives extra power. Amplifier size, 6" x 9½" x 4½" high. Heavy shielded Thordarson Hi-Fi output transformer. Response 30 to 12,000 cps. Amplifier is ready to use. Complete with tubes and speakers. (Does not have gain for mike.) Use as a record player amplifier. Stock No. HF-8, 8 watt amplifier and speakers. Ship. wt. 14 lbs. Sale price, $19.95.
Model HF-5, similar to HF-8, except 5 watts output and equipped with a single 12" dynamic speaker Sale price, $14.95.

3-STATION MASTER SUB-STATIONS $3.95 EACH

$16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MPM-A3. Ship. wt. 10 lbs., $16.95. Matching sub-station PM-A3, with 6" PM and call-back switch, $3.95 ea., 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft., 500 ft. for $8.95.

CROSLEY FM-AM TUNER

SALE PRICE $19.99

AUDIO AMPLIFIER IS REQUIRED TO OPERATE A SPEAKER

Model 262-2, 6 tubes Crosley FM AM tuner. Receives broadcast 550 to 1600 kc, FM 88 to 108 mc. With tubes: 3—6BA6, 6BE6, 12AT7 and 6T8. Power this tuner from your audio amplifier or TV set. (6.3 v. filament and 125 to 180 v. at 20 mils "B" voltage required.) Chassis 5½" x 10½" x 5½" high. Illuminated slide rule dial 6½" long. 4 position switch selects FM, AM, TV or Phono. One-half of 6T8 used as pre-amp for variable reluctance pickup. Has no volume control. Audio is fed to your TV or hi-fi amp. Those are now Crosley FM-AM tuners that cost over $30.00 to build.
Model 262-2, complete with escutcheon, knobs, diagram, instructions and parts list. Ship. wt. 9 lbs. Sale price, $19.99.
Crosley 262-2VC, same as above but has volume control and power supply added to make a self-powered AM-FM tuner. Ship. wt. 16 lbs. Sale price, $24.99.
Note: An Audio amplifier is required to operate these tuners thru a speaker.

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SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

reactive components, or the conductive and susceptive components depending on the value of the unknown. The

bridge will also measure impedances which are grounded, ungrounded, or balanced-to-ground.

An audio generator and null detector are required for use with this bridge. For full details on the operation and special features of this device, write the manufacturer direct.

MAGNAVOX MUSIC SYSTEM

The Magnavox Company of Fort Wayne, Indiana recently introduced a new line of instruments to the press and the trade.

One of the outstanding units in the audio line is the "Imperial" which is designed specifically for locations where space is at a premium. The instrument offers radio, phonograph, and record combination in matching cabinets. One cabinet houses the speakers and associated amplifier while the companion piece contains an automatic record changer and AM-FM tuner, along with controls for operating the entire system.

The "Imperial" is available in mahogany, blonde, or cherry finishes. For full details on this and other items in the company's audio equipment line,

write the firm direct or contact your nearest *Magnavox* distributor.

OUTDOOR SPEAKER CABINET

Manfredi Wood Products Corporation, 226 New York Ave., Huntington, New York is marketing a new, popular-priced portable speaker enclosure which is designed to provide durability for outdoor use.

The enclosure combines colorful cabinetry with a fully-insulated bass reflex speaker compartment. Conolite, a laminated plastic veneer, provides a selection of colorful finishes and unusual durability.

Fiberglas insulation is provided on both sides and top of the speaker compartment for use with 8" or 12" speaker cut-outs. Acoustic design is enhanced by a Fiberglas curtain to assure faithful reproduction of low tones and elimination of "boominess." Convenient cable clips for 50 feet of wire simplify connection to indoor equipment.

The cabinet measures 22" high, 16" wide, and 12" deep and weighs 20 pounds. A concealed carrying handle aids portability.

CONTROL CABINET

Components Corporation of Denville, New Jersey has developed a new, compact master control cabinet to house its "Professional" turntable as well as a tuner, preamplifier, and amplifier.

The cabinet is of chairside height (20½" long, 15½" deep, and 18" high), and is styled to complement both traditional and modern decor. The front and sides of the "Pro-Ette" are constructed

of ¼" plywood to facilitate mounting the tuner, amplifier, or other equipment desired. The back and top panels are ¾" plywood for maximum strength and the cabinet is braced and reinforced throughout.

NEW BELL RECORDER

Bell Sound Systems, Inc., 555 Marion Rd., Columbus 7, Ohio, is currently marketing a new, popularly-priced tape recorder, the Model RT-88.

The new recorder offers two speed operation *via* a three-motor tape transport mechanism. Complete push-button control is accomplished through pianolike keys arranged console fashion on the tape deck. All controls and jacks are within easy reach and are clearly marked so as to be visible from the normal operating position.

The RT-88 will record at either 3¾ or 7½ ips, the speed being selected by pressing a button. Proper equalization is accomplished automatically.

Inputs are provided for microphone and radio and outputs permit use of an external speaker or amplifier.

Power output is 3.5 watts. Frequency response is from 50 to 10,000 cps. The speaker has a 6-8 ohm voice coil.

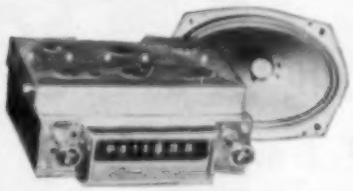
Full details may be obtained by contacting H. H. Seay, general sales manager of the firm. —30—

6 TUBE UNIVERSAL MOUNTING AUTO RADIO $19.99

LESS THAN FACTORY COST!

★ A SENSATIONAL AUTO RADIO VALUE AT A TERRIFIC LOW PRICE.
★ MADE BY A BIG NAME MANUFACTURER.
★ FULL SUPERHET—WITH TUNED R.F. STAGE—6 TUBES—TONE CONTROL.

McGee makes another tremendous purchase and passes the saving on to you. This universal mounting, 6 tube, 6 volt auto radio is a full superhet with fully tuned R.F. stage. Made to sell at a much higher price, by one of America's best known manufacturers. Its very thin and compact construction lends it to a neat underdash installation in most any car or truck. Or, you can arrange a place in the dash for custom installation. (Dial requires a cut-out 5½" long x 2½" high; two control holes on 7" centers. A minimum of 6¾" depth behind dash.) When mounted underdash it extends only 3½" below. Overall size: 9" wide, 4¼" high and 7¼" deep. Requires no more room under your dash than an ordinary auto radio remote control head. Not intended for an exact custom panel fit, but it lends itself very well for your custom installation ideas. Can be custom fit in most late model cars and trucks. Has no built-in speaker, but is furnished with a heavy duty 6x9" speaker. This is the most popular size auto radio speaker. Tubes: 6BE6, 2-6BD6, 6AV6, 6AQ5 and 6X4. Ship. wt. 12 lbs. Stock No. AM-759. McGee's sale price, $19.99 for the radio complete with 6x9" speaker. 3 section top cowl antenna, $2.29 extra.



6-TUBE, 6-VOLT
UNIVERSAL MOUNTING
AUTO RADIO
$19.99 WITH 6" x 9" SPEAKER

CAN BE CUSTOM FIT INTO THE DASH OF MOST LATE MODEL CARS AND TRUCKS

ESPEY

1st Offering—by a Famous Maker

14-Tube FM-AM Chassis
Williamson Type Circuit
Ultra-Linear Response—
20 to 22,000 CPS

SALE PRICE $84.95
LESS SPEAKER

With 15" Coax. $99.95

10 WATTS HI-FI AUDIO

New 1956 model, 14 tube FM-AM chassis. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt radio. You could spend $200 to $250 for a separate tuner and amplifier and not have the quality of this receiver. Ultra-Linear output used in Williamson type circuit gives frequency response of 10 to 22,000 cps. Output taps of 4, 8 and 16 ohms. Separate RF stages for FM and AM assure high sensitivity. Temperature compensated FM front end for minimum drift. Separate bass and treble tone controls. Pre-amp for all types of magnetic cartridges. 2nd input for crystal phono, tape recorder or TV. 3 position equalizer for accurate reproduction of all records. Built-in antenna for both FM and AM. Response plus or minus 1 db from 10 to 22,000 cps at 2 watts. Harmonic distortion less than 1%. Sensitivity: FM, 8 mv for 30 db quieting; AM, 75 mv for 6 db signal to noise ratio. Off-on-volume and equalizer are combined on a concentric control. Has 2 AC outlets on rear of chassis. Beautiful edge lighted flywheel inertia slide rule dial. Size: 7¾"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable) Model HF-250C, Sale price, $84.95. With heavy duty Utah 15" coaxial PM speaker, both for only $99.95.

NEW—SMALL VOLT-OHM METER

2000 OHMS PER VOLT
AC-DC
WITH TEST LEADS

McGEE SCOOP SALE PRICE $9.95

New, small volt-ohm meter 5¼" tall, 3½" wide and 1⅝" thick. Sensitivity 2000 ohms per volt. DC volts 0 to 1000 in 5 ranges; AC volts 0 to 1000 in 5 ranges; DC current 0 to 500 ma. in 3 ranges; Resistance 2 ohms to 1.5 megohms in 3 ranges; Decibels minus 20 to plus 16 (0db .774 Volts). A thin, compact instrument small enough to fit in your service kit. A fine imported instrument specially priced at $9.95 for this Radio & TV News ad. Never before have we offered an instrument value like this. Model No. TP-5, complete with test leads. Sale price, only $9.95. Ship. wt. 2 lbs.

6" SESSIONS CLOCK-TIMER

With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9¾" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6½" x 4" high and 2½" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63. Sessions Clock Timer with case of your color choice. Sale price only $3.95.

4" Telechron clock-timer with 2½" clock face. Clock has sweep second hand and 15 amp. 125 volt appliance switch to turn on at any pre-set time. Made for clock-radio with appliance outlet. Has lullaby switch to allow radio or appliance to run up to one hour and shut-off automatically. Requires 2" mounting depth. Telechron Clock-Timer, Stock No. TCT-42 (not pictured). Sale price, $3.95.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

A sensational value. A 50 watt booster amplifier with push-pull, parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X pre-amplifier to allow the use of 2 microphones and one low level input. The amplifier has one input jack with 1 volt input giving 50 watts of audio. Amplifier has a 6 lb. potted case high fidelity output transformer with taps of 4-8-16-60 and 250 ohms. 325 mil power transformer and 5U4G rectifier. Includes tubes: 4—6L6, 7N7 and 5U4G. Two variable tone controls for master volume and bass boost tone control. Chassis size, 8" x 8½" x 14½". Model No. PA-50W. Ship. wt. 26 lbs. Sale price, $39.95. PR-2X, 2 mike input pre-amplifier plugs in directly to the PA50W 50 watt booster amplifier. Allows use of 2 microphones, either crystal or dynamic and one low level input. Furnished with 4 ft. connecting cable and plug for remote control of the 50 watt booster. Chassis size, 3¼" x 3½" x 2½". Model PR-2X, Sale price, $12.95.

8", 10", 12" SPEAKER-BAFFLE COMBINATIONS

8" - $3.95 10" - $4.95 12" - $6.95

Our most popular speaker-baffle combinations. Brown leatherette covered wood baffle and 8", 2.8 oz. Alnico V magnet speaker. Most economical wall speaker. Stock No. 818-K. Sale price, $3.95 each. Lots of 3 or more, $3.79 each.

Brown leatherette covered wood baffle and 10", 3.16 oz. Alnico V magnet speaker, at little more than the 8" size. Stock No. CA-10Z. Sale price, $4.95. Lots of 3 or more, $4.79 each.

Brown leatherette covered wood baffle and 12" RCA PM speaker. A terrific McGee value. Only $00 to sell. You get the baffle and speaker for the value of the speaker only. Stock No. RCA-812. Sale price, $6.95. Lots of 3 or more, $6.79 each.

MINIATURE BROADCASTING STATION FOR THE HOME

NEW 1955 MODEL WITH CRYSTAL MIKE $9.95

Sensational new model MCL-83 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control feeds from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

$59.95 TIMEX MAGNETIC RECORDER

SPECIAL SALE PRICE $29.95

CRYSTAL PICKUP TO PLAY PHONO RECORDS $2.95 EXTRA

SALE PRICE $29.95
MODEL 40 TIMEX

RECORDS AND PLAYS BACK PLAYS 16⅔ AND 45 RPM RECORDS

A product of United States Time Corp. (Timex) A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adapter and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 8½x11½x6½". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AT7, 90C1, 6C4 and 1SW4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-R1 recorder, ship. wt. 12 lbs. Sale price, $29.95.

Recording discs, package of 6 for 90c. One blank shipped with recorder.

You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

ATTENTION! TV SERVICEMEN PICTURE TUBE RESTORER-TESTER

NEW—POWERFUL TRANSFORMER OPERATED $49.95

Designed to rejuvenate television picture tubes that have become weak due to cathode deterioration. Also repairs shorts and welds open elements in most cases. We have tested several makes and offer this unit as the best value in its field. This unit weighs a full 20 lbs. It incorporates a heavy power transformer. It is more equipment and more for your money. Will perform as well as units selling above $100.00. Relay controlled flashing cycle reduces operating technique to a simple operation. Effective on 90% of all picture tubes. A built-in test feature gives quality test on new or old tube to determine condition before and after rejuvenation. We think every active TV Service Dealer should have a rejuvenator of this type. Operating instructions included. Fully guaranteed. Stock No. AJ-59, ship. wt. 20 lbs. (not mailable). Sale price, $49.95.

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PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
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Within the Industry

(*Continued from page 32*)

new executive vice-president of *Bogue Electric Manufacturing Co.* He was formerly with *Sperry Gyroscope Company* . . . **FRANKLIN GREENE, JR.**, formerly manager of *General Electric Company's* radio and television department's Bleeker Street radio plant in Utica has been named manager of television manufacturing with headquarters in Syracuse . . . **P. NEWTON COOK** has been appointed general sales manager of *Chicago Standard Transformer Corporation* . . . **SAMUEL W. ARCHER** who has been service manager for the *Delco Radio Division* has been named assistant general merchandising manager for the *United Motors Service Division* of *General Motors* . . . **G. E. WRIGHT** has been elected president of *Bliley Electric Company* of Erie, Pa., succeeding the late **F. DAWSON BLILEY** . . . **D. R. TASHJIAN** has been appointed manager of engineering for *Westinghouse Electric Corporation's* electronics division in Baltimore, Maryland . . . **HENDRIX G. BLUE** has been named to the newly-created post of sales promotion manager of *The Hallicrafters Company* . . . **W. WALTER JABLON** has been appointed general sales and advertising manager of the *Presto Recording Corporation*. He succeeds **THOMAS B. ALDRICH** who has left the firm to go into business for himself . . . **CHARLES F. BAXTER** is the new general manager of the *RCA Victor* television division of *Radio Corporation of America*. He has been assistant general manager of the division since 1949 . . . **GEORGE ROWEN** has been elected a vice-president of *Sparks-Withington Company* and general manager of the firm's electronics division . . . *Fairchild Recording Equipment Company* of Whitestone, N. Y., has named **RUBEN E. CARLSON** to the post of manager of its high-fidelity division and **ROBERT G. BACK** to the position of manager of promotion and distribution . . . **E. S. SEELEY**, chief of engineering of *Altec Service Corporation* in New York, has been named director of engineering for *Altec Lansing Corporation* in Beverly Hills, California . . . The appointments of **RICHARD C. KOCH** as chief engineer and **ROY G. TRUE** as executive vice-president have been announced by *I.D.E.A., Inc.* . . . *Mid-Century Instrumatic Corporation* has named **NELSON A. MERRITT** to the post of chief engineer . . . **JOHN R. HOWLAND** has been appointed general sales manager of the *Dage Television Division* of *Thompson Products, Inc.* He will supervise the sale of the firm's color television systems and black-and-white equipment for closed circuit applications . . . **DR. DONALD W. COLLIER** and **CHARLES HOWE GODDARD** have been elected vice-presidents of *Thomas A. Edison Incorporated* . . . **FORREST E. BEHM** will head the newly-activated Components Department of *Corning Glass Works'* Electrical Prod-

ucts Division . . . Promotion of **ROBERT A. VON BEHREN** to research and development manager of the magnetic products division has been announced by *Minnesota Mining & Manufacturing Co.* He has been with the firm since 1948 . . . **LARRY S. RACINE,** president of *Chicago Standard Transformer Corporation* has taken an indefinite leave of absence from his post because of ill health. **WILLIAM J. SHEA,** chairman of the board and chief executive officer of the firm, is assuming the office of president . . . **NORMAN C. OWEN** has been appointed manager of distribution for *Zenith Radio Corporation.*

* * *

NORMAN L. HARVEY is the new chief engineer of the radio and television division of *Sylvania Electric Products Inc.* He will direct the design of all products manufactured by the division, with headquarters at Buffalo, N.Y.

A member of the *Sylvania* organization since 1941, Mr. Harvey was transferred temporarily from the radio and television division to help set up the company's new electronics systems division, which he served as assistant general manager and chief engineer. With the recent expansion of the radio and television division, he has now been returned to the post as chief engineer.

* * *

J. H. CRAFT, JR. of *Stromberg-Carlson* has been appointed chairman of the Service Committee of the Radio-Electronics-Television Manufacturers Association for the fiscal year 1955-56. He succeeds H. J. Schulman of *CBS-Columbia.* The committee directs RETMA activities in the field of radio-television set servicing.

Mr. Craft named W. L. Parkinson of *General Electric Company* to be chairman of the Vocational Training Subcommittee and J. A. Hatchwell of *Allen B. Du Mont Laboratories, Inc.* to be chairman of the Advisory Committee to the New York Trade School. Mr. Hatchwell will also serve as vice-chairman of the Service Committee.

* * *

IRVING KOSS, formerly a Major in the Signal Corps, has joined *Motorola Inc.* as administrative assistant to Daniel E. Noble, vice-president in charge of the Communications & Electronics Division of the firm.

A native of Massachusetts, Mr. Koss graduated from MIT before entering the Army in 1942. Since that date he has held many responsible positions, all associated with electronics and communications—some civilian and other military assignments.

While in the Army, he earned his MBA at the Harvard Graduate School of Business Administration. —30—

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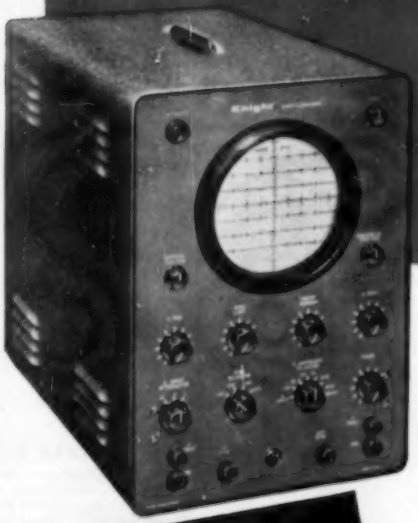
SAVE! ALLIED—the reliable name in Electronics—gives you the greatest value for your test instrument dollar in KNIGHT Kits.



NEWEST PRINTED CIRCUITS

KNIGHT PRINTED CIRCUIT 5" OSCILLOSCOPE KIT

Model F-144 $69.00

$6.90 down, $6.00 monthly for 12 months

New wide-band, full-size 5" Oscilloscope; equals or betters the performance of commercially-wired 'scopes costing several times the price. Two printed circuit boards and exclusive laced wiring harness cuts assembly time to minimum. Ideal for the professional Laboratory, for color TV servicing and high frequency applications. Has 6 times the usual sweep range—from 15 to 600,000 cps. Locks in frequencies as high as 9 mc. Vertical response from 5 cycles to 5 mc. Response: ± 1 db at 3.58 mc; ± 3 db at 5 mc. High vertical sensitivity of 25 rms millivolts/inch. Input capacitance 20 mmf. Outstanding features: cathode-follower vertical and horizontal inputs; 2nd anode provides 1400 volts for high-intensity trace; push-pull vertical and horizontal amplifiers; positive and negative locking; faithful square wave response; frequency-compensated input attenuator; Z-axis input for high-intensity modulation; one volt peak-to-peak voltage calibration; internal astigmatism control; blanking circuit to eliminate retrace lines; DC positioning control. Complete with all tubes and parts, ready for easy assembly. Handsome professional case finished in blue, with gray control panel. Shpg. wt., 40 lbs.

Model F-144. Knight Printed Circuit 5" Oscilloscope. Net only $69.00
Model F-148. Demodulator Probe. Net $3.45
Model F-147. Low Capacity Probe. 12 mmf. Net $3.45

BUY WITH CONFIDENCE
BUILD WITH CONFIDENCE

KNIGHT Kits are engineered to bring you the latest advances in electronic instrument design. The use of premium quality components assures absolute dependability.

KNIGHT Kits are designed for easiest assembly. It's just like having a good instructor at your side.

You and ALLIED are a team. ALLIED stakes its 30-year reputation in the Electronics field on your complete success and satisfaction.

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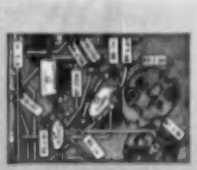
You just follow each step and check it off as you complete it. You always know where you are and what to do next with the wonderfully clear KNIGHT Manuals.

EXCLUSIVE ALLIED "KING-SIZE" DIAGRAMS

Diagrams are duplicated in large wall size to hang conveniently over your work. Helps you see and understand the finest details clearly and easily.



EXCLUSIVE ALLIED "SPOTLIGHT" PICTORIALS

Special two-tone treatment makes it easy for you to spot the circuit you're working on, separates it from work you've already completed. "You always know where you are."

EASY PAYMENT TERMS

If your total Kit order is over $45, take advantage of our liberal Time Payment Plan—only 10% down, 12 full months to pay. Write for application form.

NEWEST PRINTED CIRCUIT

KNIGHT PRINTED CIRCUIT VTVM KIT

Model F-128 $24.95

New extremely stable, highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Features maximum convenience in arrangement of scales and controls. With peak-to-peak scale for FM and TV work. Ranges: AC peak-to-peak volts, 0-4-40-140-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; ohms, 0-1000, 10K, 100K; 1-10-100-1000 megs; db scale, −10 to +5. Uses low-leakage switches and 1% precision resistors. Balanced-bridge, push-pull circuit permits switching to any range without adjusting zero set. 4½" meter, 200 microamp movement. Polarity reversing switch. Input resistance, 11 megs. Complete kit, ready to assemble. Shpg. wt., 6 lbs.

Model F-128. Knight Printed Circuit VTVM Kit. Net only $24.95
Model F-126. Hi-Voltage Probe; extends DC range to 50,000 Volts. Net $4.50
Model F-127. Hi-Frequency Probe; extends AC range to 250 mc. Net $3.45

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PORTABLE TUBE TESTER

Model F-143

$29.75

KNIGHT EASY-TO-BUILD TUBE TESTER KIT—OUTSTANDING VALUE

Expertly designed, up-to-date, ideal for the laboratory or service shop. Remarkably low priced, yet it offers high accuracy, top versatility and convenience. Features provision for testing 600-ma tubes; roll-chart data for all popular series-string types. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. Single-unit, 10-lever function switch simplifies assembly. Illuminated roll chart lists over 700 tube types. Complete kit, ready for easy assembly. Shpg. wt., 14 lbs.

Model F-143. Counter type Knight Tube Tester Kit. Net only **$29.75**
Model F-142. As above, but with carrying case. Net only **$34.75**
Model F-141. TV Picture Tube Adapter for above. Net only **$3.75**

BUY WITH CONFIDENCE

- Advanced Electronic Design
- New Printed Circuits
- Easy-View, Hi-Legibility Panels
- Professional Streamlined Styling
- Matched Instruments
- Premium Quality Components

Model F-119

$11.65

KNIGHT CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and trouble. Just press a button and the "magic eye" instantly shows opens and shorts. Checks by-pass, blocking, coupling and filter condensers from 20 mmf to 2000 mfd, even when the capacitor under test is wired with a resistance as low as 60 ohms. Capacitors between .1 mfd and 2000 mfd may be tested even when in parallel with resistance as low as 2 ohms. Housed in the professionally styled Knight Kit case, sturdy steel in blue wrinkle finish with gray control panel. Complete kit, ready for easy assembly. Shpg. wt., 5 lbs.

Model F-119. Knight Capacitor Checker Kit. Net only **$11.65**

KNIGHT 20,000 OHMS/VOLT VOM KIT

Model F-140 Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; ± 2% full scale deflection; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust". Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, −30 to + 63 in 6 ranges. Uses precision 1% multipliers. Complete kit with bakelite case, batteries and test leads. Shpg. wt., 5 lbs.

$26.50

Model F-140. Knight 20,000 ohms/volt VOM Kit. Net **$26.50**

KNIGHT 1,000 OHMS/VOLT VOM KIT

Model F-128 Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and Output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, −20 to + 69 in 6 ranges. Uses 1% precision resistors. 3-position function switch and 12-position range switch. Complete kit with bakelite case, battery and test leads. Shpg. wt., 2½ lbs.

$14.25

Model F-128. Knight 1,000 ohms/volt VOM Kit. Net **$14.25**

Model F-124

$18.75

KNIGHT RESISTOR-CAPACITOR TESTER KIT

This new highly accurate tester meets the critical requirements of lab and service shop. Measures capacitance and resistance; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" for correct dial setting. Measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to .006 mfd, .001 to .5 mfd, .1 to 50 mfd and 20 to 1000 mfd. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ± 10%. Automatic discharge feature prevents after-test shock. Complete kit with Knight professional portable case. Shpg. wt., 8 lbs.

Model F-124. Knight Resistor-Capacitor Tester Kit. Net only **$18.75**

EASY PAYMENT TERMS: If your total kit order comes to over $45, take advantage of our liberal Time Payment Plan—only 10% down, 12 full months to pay. Write for application form.

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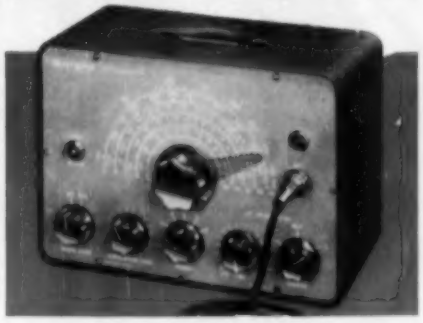
KNIGHT LOW-COST RF SIGNAL GENERATOR KIT



An extremely popular kit, noted for its wide range and exceptional stability—saves you two-thirds the cost of a comparable wired instrument. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonic output to 220 mc. Ideal for aligning RF and IF stages and for audio equipment troubleshooting. Also serves as TV marker generator when used with any sweep generator. Features the famous Colpitts circuit for high accuracy with negligible drift. RF output rated over 100,000 microvolts. Output can be modulated at 400 cycles. Has built-in sine-wave audio oscillator with output jack for 400 cycle output. Maximum audio output, 10 volts. Jack for external modulation; step and continuous-type output attenuators. Complete kit with professional portable case. Shpg. wt., 10 lbs.

Model F-145 $19.75

Model F-145. Knight RF Signal Generator Kit. Net only $19.75

BUILD WITH CONFIDENCE

- Crystal-Clear Instruction Manuals
- Exclusive "Step-and-Chek" Building Method
- Exclusive "King-Size" Diagrams
- Exclusive "Spotlight" Pictorials

SAVE MONEY! Depend on ALLIED—the world's largest Electronic Supply House—get the most for your test instrument dollar.

KNIGHT VISUAL-AURAL SIGNAL TRACER KIT

A remarkable value in a kit which permits visual and aural signal tracing of RF, IF, video and audio circuits—costs no more than an audio signal tracer alone. Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: high usable gain of 50,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; RF probe for checking all stages; special audio probe tip included; provides noise test; built-in watt meter calibrated from 25 to 1000 watts; provision for external scope or VTVM. Complete kit with portable case. Shpg. wt., 13 lbs.

Model F-135 $23.75

Model F-135. Knight Visual-Aural Signal Tracer Kit. Net only $23.75

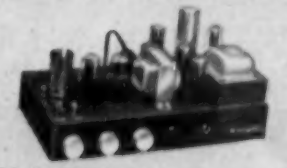
Model F-137 $31.50

KNIGHT AUDIO GENERATOR KIT

Save money—have performance equal to instruments at many times the price! Provides an ideal audio frequency source for checking audio circuits of amplifiers and other hi-fi equipment; also checks speaker response. Frequency range: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts to high imp., ± 1 db to 200 kc. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Continuously variable step-attenuated output. Circuit as developed by U. S. Bureau of Standards. Complete kit with professional portable case, ready to assemble. Shpg. wt., 17 lbs.

Model F-137. Knight Audio Generator Kit. Net . $31.50

KNIGHT AMPLIFIER KITS FOR HI-FI BUILDERS



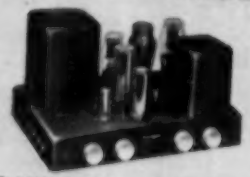
10-WATT HI-FI AMPLIFIER KIT

Model S-234 $20.95

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ± 1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chassis punched to accommodate preamp kit. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-234. Amplifier Kit. Net . $20.95

Model S-235. Preamp Kit for above. Net $2.75



20-WATT HI-FI AMPLIFIER KIT

Model S-750 $34.75

True hi-fi for less! Frequency response, ± 1 db, 20 to 20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono, 72 db below 20 watts. Sensitivity: tuner input, 0.6 volt for 20 watts output; magnetic phono, .007 volts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records, controlled from front panel. Shpg. wt., 33 lbs.

Model S-750. 20-Watt Hi-Fi Amplifier. Net $34.75

HAM SPECIAL!

Model S-725 $27.50

KNIGHT SELF-POWERED VFO KIT

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristic for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate scales for 40, 20, 15 and 10 meters (11 and 80 meters have combined scale); vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. Complete kit for easy assembly. Shpg. wt., 8 lbs.

Model S-725. Knight Self-Powered VFO Kit. Net . $27.50

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Allied Radio Corp., Dept. 1-K-5, 100 N. Western Ave., Chicago 80, Ill.

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My check ☐, money order ☐, for $. . . . . .is enclosed.

Name _____

Address _____

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ORDER TODAY

Weather Detection Radar

United Air Lines is currently installing RCA's new C-band radar units in its fleet. Pilots can determine possible corridors through storm areas for smoother flights.

RCA's new, compact, 125 lb. airborne radar set provides increased passenger comfort.

A NEW and unique airborne radar unit especially designed by *RCA* for commercial and executive planes is now being installed in *United Air Lines'* entire fleet.

Use of the new C-band (5.5 cm.) radar enables pilots to determine corridors for smooth flight through storms which appear solid to the unaided eye. Excessive turbulence can thus be bypassed, resulting in greater passenger comfort. Schedule regularity will also benefit since time-consuming detours around storms no longer will be required.

The new AVQ-10 radar unit is designed primarily for weather detection rather than for terrain mapping or the detection and avoidance of aircraft. Its terrain mapping ability, however, is sufficiently good to identify deep river beds, large lakes, mountain ridges, peaks, and other surface features.

The indicator is a 13-pound shock-mounted unit with a 5" viewing screen.

It produces a 360 degree continuously rotating PPI-type presentation giving an effective forward "looking" sector of approximately 270 degrees. This sector will vary slightly with the plane.

Four controls are provided on the face of the indicator. One of three ranges may also be selected, 25, 50, or 150 nautical miles.

The control panel, a small inconspicuous unit, provides for selection of all the necessary radar functions with a minimum of controls. It is designed for plug-in installation. The balance of the equipment (transmitter-receiver, accessory unit, and antenna gear mechanism) can all be housed outside the cockpit if desired. —30—

L. E. Sebald of UAL demonstrates antenna of C-band radar installed on "Mainliner O'Connor." Nose of Convair 340 has been extended 28½" to house antenna and gear unit.

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Basic Radio Manual. A comprehensive training guide, outlining step-by-step a 36-Lesson Course on Basic Radio accompanied by a practical Shop Project section devoted to actual job projects that implement the lessons and clearly translate theory into practice. 248 pages, 8½ x 11", illustrated. Order **ED-1** **$5.00**

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Radio Receiver Servicing. A book on practical radio receiver servicing covering such basic troubles as dead set, weak set, intermittent and noisy sets, etc. 192 pages, 5½ x 8½". Order **RS-1** **$2.50**

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HI-FI QUIZ

By ED BUKSTEIN

(Answers on page 189)

1. An amplifier whose gain is greater for high-amplitude signals than it is for low-amplitude signals is known as:

(a) volume compressor
(b) volume expander
(c) volume limiter

2. The abbreviation "ips" used in reference to tape recording means:

(a) in-phase signal
(b) inches-per-second
(c) inverted polarity switch

3. A loudspeaker designed for high audio frequencies is known as:

(a) a woofer
(b) a puffer
(c) a tweeter

4. A turnover cartridge is used:

(a) to permit playing of either standard or microgroove records
(b) to automatically play both sides of a record
(c) to reverse the motor at the end of a tape recording

5. The process of removing previous recordings from a tape is known as:

(a) squelching
(b) limiting
(c) erasing

6. The circuit used to separate the high and low audio frequencies and to feed them to separate loudspeakers is known as:

(a) a crossover network
(b) a loudness control
(c) a volume expander

7. Which of the following is not a type of loudspeaker enclosure:

(a) infinite baffle
(b) bass reflex
(c) reflex klystron

8. A coaxial loudspeaker is:

(a) any loudspeaker connected to an amplifier by a coaxial cable
(b) two loudspeakers, one inside the other
(c) a type of loudspeaker which can be used on AM but not on FM receivers

9. A control that simultaneously varies both the volume and the frequency response of an amplifier is a:

(a) loudness control
(b) voltage regulator
(c) d.c. restorer

10. A microphonic tube is one with loose elements:

(a) true
(b) false

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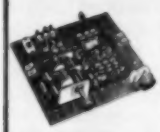

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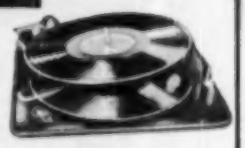

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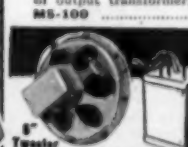

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Training Technicians

(*Continued from page 55*)

Minor cabinet repairs should be covered so that the graduate technician can take care of minor scratches and dents in cabinets. Most professional technicians turn major cabinet repair jobs over to skilled cabinet makers, however.

Actual servicing techniques and the use of servicing instruments should be covered in full detail. Any course of training should include actual practice in the use of such techniques as "effect-to-cause" reasoning, signal tracing, signal injection, alignment, stage-blocking tests, circuit disturbance tests, etc. Adequate background study and practice in the use of instruments such as the multitester, tube tester, signal generator, and signal tracer should be given. For TV servicing, additional training in the use of the oscilloscope, the sweep generator, the square-wave generator, and the cross-hatch generator, should be given. A really thorough course, covering specialized work in the service of audio amplifiers as well as the service of radio and TV receivers, would also include training in the use of sine-wave audio generators and intermodulation testers.

Experience. One real measure of a service technician's skill is his ability to service receivers rapidly and efficiently. An important factor in developing this ability is experience with actual receivers. Only through experience can the technician become familiar with the more common complaints encountered in commercial receivers. Only through experience can the skill of going right to the heart of the trouble without first going through a step-by-step servicing technique be developed. Only through experience can the ability to recognize, at a glance, the most common troubles of commercial receivers be developed, as well as the knowledge of the weaknesses of particular models or makes of sets. Experience is also valuable in developing the service technician's confidence in his own ability and skill, thus permitting him to undertake even the most difficult servicing jobs with full knowledge that he will be able to successfully complete the repairs in a minimum of time.

Therefore, any course of training should include work which will permit the student to obtain actual experience on commercial receivers. In resident schools, this can be easily done by making arrangements with one or more local repair shops to furnish trade-in sets to the school for repair and reconditioning. In correspondence courses, this can be done by a suggested practical training plan which will permit the student to obtain an actual commercial receiver and then to introduce common defects, noting how these defects affect set operation and how the symptoms obtained give a clue as to the source of trouble. The

correspondence school student can expand the value of this type of training by purchasing trade-in sets or used sets and repairing and reconditioning them himself, using the consultation service offered by the correspondence school to aid him.

Summary

The prospective radio-TV service technician must be guided by many factors in choosing a course of training. Some of these factors are personal, such as time available, financial resources, etc. Some of these factors are vocational—type of training available locally, whether the technician plans to specialize, whether he plans to enter business for himself or to start work as an employee in a large service shop, etc.

Having considered all of these factors and decided on the type of training best suited to his personal requirements, the prospective technician should then contact the available sources of training. If he plans to enter a service shop as an apprentice, he should contact several shops, not just one. He should make sure that the shop offering him a job as an apprentice plans to offer genuine training and not just consider him as an "odd jobs" man.

Should the prospective technician decide to attend a resident school, he should contact all the schools which he might be able to attend. Find out not only about the cost of the training and the time required, but also obtain full details on course outlines. If possible, the school should be personally visited. Facilities should be inspected. Present students and recent graduates should be contacted. In general, the prospect should obtain all available information on the school before signing a contract. He should remember that he will invest considerable time and work as well as money in his training, and, therefore, should make every effort to obtain full value.

Should the prospective technician decide to take a correspondence course of training, he should make sure that the course offered covers the field adequately and that fundamentals are studied in sufficient detail. He should make sure that practical training is offered, either through resident work at the school or through experimental kits (this is not as important if the student plans to take a correspondence course while serving a period as an apprentice, for he will then receive practical work in his day-to-day job). The school should offer personal consultation service, not only on his training, but on the application of his acquired knowledge to practical servicing work.

And, finally, once the prospective technician has decided on his plan of training, he should make every effort to thoroughly master that training. In the final analysis, the value of any training depends a lot on the individual taking the course and his willingness to meet his course half way!! —30—

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D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
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CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
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Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

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QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

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It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

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The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

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The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

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One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.
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The Model TC-55 comes complete with operating instructions and charts. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

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About Testing Picture-Tubes...

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Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C.R.T. TUBE TESTER

Tests all magnetically deflected tubes...in the set...out of the set...in the carton!!

SPECIFICATIONS:

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

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This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

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The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

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Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence*. When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

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The Model TV-50 comes absolutely complete with shielded leads and operating instructions. Only ——————

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A Cathode-Follower Amplifier

Over-all view of the author's 3-watt cathode-follower amplifier. It is built on a chassis measuring 5" x 7".

By **RALPH C. JOHNSTON**

Details on a novel all push-pull amplifier with cathode follower output, using a low-cost output transformer.

THE audio experimenter may have noticed that most of the popular circuits use a relatively expensive output transformer. These transformers have high primary inductance, low leakage inductance, and low distributed capacity, and may represent one of the most expensive items in the high-fidelity amplifier. However, it is possible to extend the low-frequency response of an inexpensive output transformer by using it in a cathode-follower circuit. This is because of the large amount of negative feedback introduced in a cathode follower. Another feature of the circuit is its good damping. The output impedance of the amplifier is so low, that the damping is limited principally by the d.c. resistance of the output winding, a fraction of an ohm.

When most people think of a transformer cathode-follower amplifier, they think of an inefficient circuit using half a dozen 6L6's in push-pull parallel and a transmitter-sized power supply. This is what is required if power on the order of 10 or 15 watts is to be obtained. As the output power goes up, the factors of driving voltage, power supply size, and current rating of the output stage are compounded. The author believes he has reached a good compromise at 3 watts. A single 12BH7 dual triode is used as an output tube.

In quest of more power, a pair of 12B4's was considered. After the circuit was designed, it was found that a 500-volt supply was needed to get enough driving voltage, and that only two more watts of power were obtained.

Since the amplifier was designed for a phonograph, it was found convenient to eliminate the phase inverter, and take balanced output directly from the cartridge. Power supply hum and extraneous pickup are effectively eliminated since these effects are balanced and tend to cancel in the output stage.

Two output transformers were tried in the circuit. One was a *Merit* A-2936, which is a 10-watt replacement transformer selling for less than $2.00 net. The other was a *Peerless* S-510-F, a 10-watt transformer having a response ± 1 db, 20-30,000 cps.

Fig. 3 shows the simplified equivalent circuits for a transformer in the plate and in the cathode circuit. Analysis of the low-frequency circuit is fairly simple. When the reactance of the primary of the transformer becomes low enough, it loads the circuit and the response drops off. The cathode follower's lower output impedance allows the primary reactance of the transformer, and thus the frequency, to go much lower before the loading effect of the transformer becomes apparent. When numerical values are substituted in the equivalent circuit, it is found that the low-frequency response is extended about 10 times.

Analysis of the equivalent circuit for high frequencies becomes complicated because the various distributed capacities and leakage inductances are difficult to determine. It was found experimentally that the high-frequency response was attenuated somewhat when using the *Merit* transformer in a cathode-follower circuit. The high-frequency response of the *Peerless* transformer, on the other hand, was hardly affected.

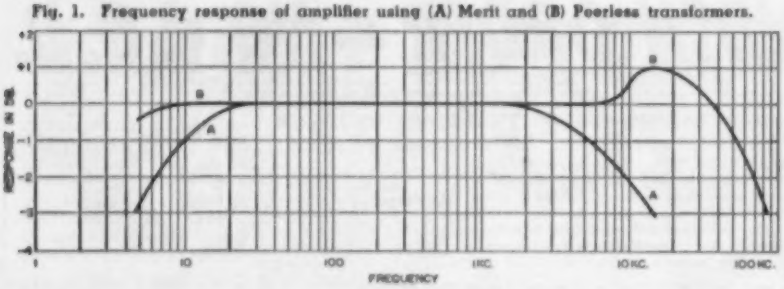
Direct coupling is used throughout the amplifier except between V_2 and V_3. The cathodes of V_2 and V_4 are run at the same voltage as the plates of V_1 and V_3 respectively. This arrangement eliminates four coupling capacitors and four grid resistors. It also helps the low-frequency response and the stability of the feedback loop at these frequencies.

Since this is an all push-pull circuit, it is important that it be balanced. The constructor should balance the components of the two halves of the circuit as well as he can with the equipment available. However, there are certain features about the circuit which tend to correct any unbalance. R_8 and R_{11} are unbypassed resistors common to both halves of the circuit and provide phase inverter action to correct unbalance. Negative feedback amounting to 15 db is used around the three voltage amplifier stages. This broadens the frequency range and lowers the distortion which is present in high level driver stages.

The output stage consists of a 12BH7 used as a push-pull cathode follower. Resistor R_{15} is used to provide the correct grid bias, allow direct coupling, and to reduce the plate voltage so that the plate dissipation rating will not be exceeded.

Since the cathodes of V_2 and V_4 run around 100 volts above ground, there was the danger of heater-cathode leak-

Fig. 1. Frequency response of amplifier using (A) Merit and (B) Peerless transformers.



R_1-R_3—3 megohm dual pot
R_4, R_9—1800 ohm, ½ w. res.
R_5, R_6, R_7—100,000 ohm, 1 w. res.
R_8—47,000 ohm, 2 w. res.
R_{10}, R_{20}, R_{21}, R_{22}—100,000 ohm, 2 w. res.
R_{11}—22,000 ohm, 1 w. res.
R_{12}, R_{13}—470,000 ohm, ½ w. res.
R_{14}—470 ohm, ½ w. res.
R_{17}—10,000 ohm, 1 w. res.
R_{18}—3500 ohm, 10 w. wirewound res.
R_{19}, R_{23}—5.6 megohm, ½ w. res.
R_{24}—500 ohm, 10 w. wirewound res.
R_{25}—270,000 ohm, 1 w. res.
R_{26}—100,000 ohm, ½ w. res.
C_1, C_4, C_7, C_8—20/20/20/20 μfd., 450 v. elec. capacitor
C_2, C_3—.047 μfd., 400 v. capacitor
C_5, C_6—50/50 μfd., 150 v. elec. capacitor
C_9—.003 μfd. ceramic capacitor
T_1—Output trans. 10,000 ohms c.t. to v.c. (see text)
T_2—Power trans. 325-0-325 v. @ 55 ma.; 5 v. @ 2 amps; 6.3 v. c.t. @ 2 amps (Stancor PC-8407)
S_1—S.p.s.t switch
F_1—½ amp fuse V_1—12AX7 tube V_2—12BH7 tube
V_3—12AY7 tube V_4—12AT7 tube V_5—6X4 tube

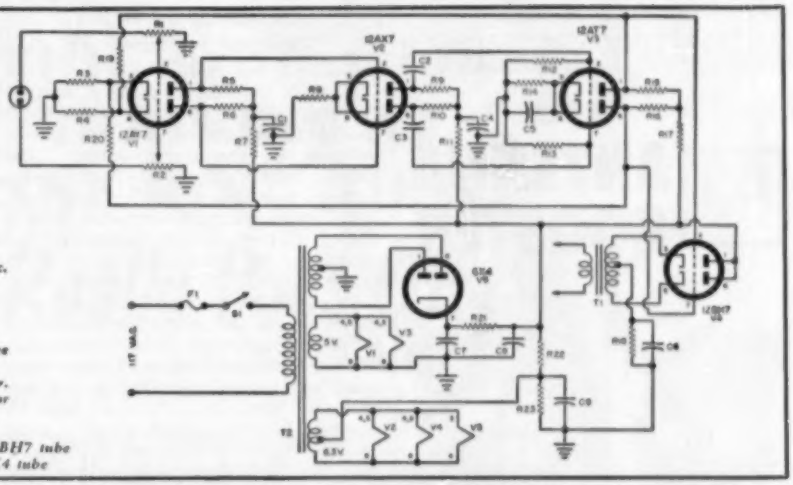
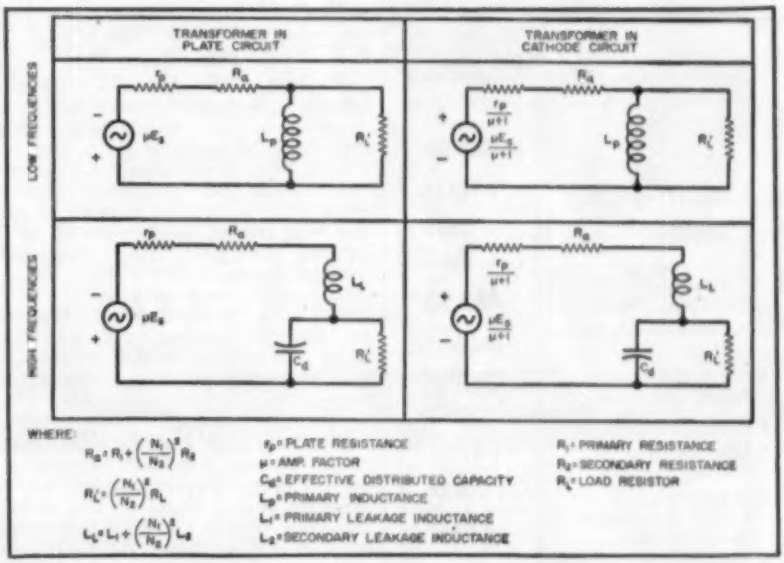


Fig. 2. Schematic of cathode-follower amplifier. An inexpensive output transformer and single dual-triode output tube are used.

Fig. 3. Simplified transformer equivalent circuits. See discussion in the article.



age or breakdown. The ideal solution would be to run the heaters of these tubes at 100 volts above ground, and use a second 6.3 volt winding for the remaining tubes. No suitable transformer was found so V_1 and V_2 were run off of the 5-volt winding, with no apparent ill effects.

Almost any transformer of the stated impedance will work in the circuit. To obtain good high-frequency response, a transformer having low leakage inductance should be used. The primary inductance is not too important because the cathode follower circuit provides good low-frequency response with small values of primary inductance.

To take full advantage of the amplifier, it is recommended that a wide range ceramic cartridge such as the *Electro-Voice* Model 84 be used. It gives results comparable to a magnetic cartridge and needs no preamplifier or compensation.

The amplifier was constructed on a 5 by 7 inch chassis. The *Peerless* transformer would require a slightly larger chassis.

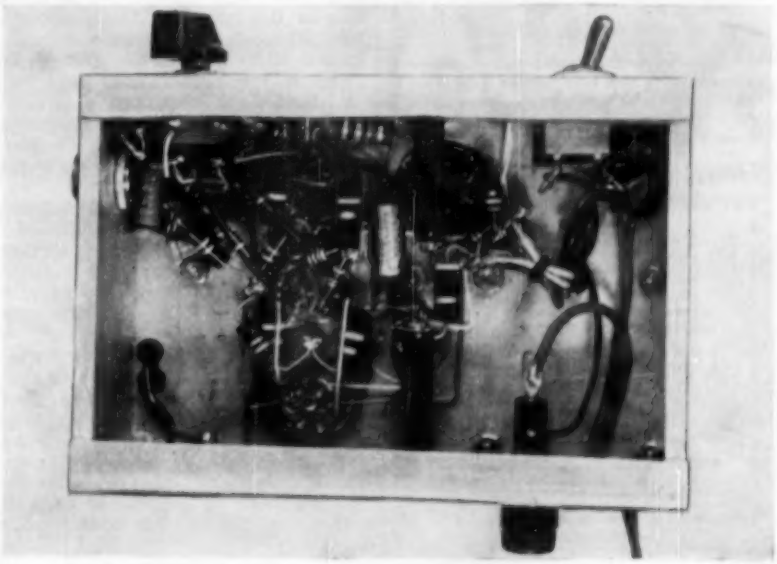
Two-conductor shielded wire should be used between the amplifier and pickup. A shielded lead similar to the one now in the changer arm was placed in the arm to give a balanced lead.

The amplifier is being used with a *G-E* S-1201A speaker mounted in a home-built "Super Horn"[1]. The power output is more than adequate since one must shout to be heard when full power is being used. Visitors are amazed to hear such fidelity and volume level from the pint sized output transformer and 12BH7.

REFERENCE

1. Gately, E. & Benham, T. A.: "Super Horn—A Folded Horn Enclosure," Radio & Television News, *September, 1953.*

—30—



Under chassis view. A larger base can be used if construction seems too crowded.

A.C.-D.C. Servicing

(Continued from page 59)

5. With voltage at point *B* normal or fairly normal, proceed with "B+" check. Measure the plate and screen voltages at the audio output tube (25L6, 50L6, 3Q5, 50B5, etc.), audio voltage amplifier (6SQ7, 1H5, 6Q7, 1S5, 12AT6, etc.), i.f. amplifier (6SK7, 12SK7, 1T4, etc.), and converter tube including the oscillator anode grid (12SA7, 1R5, 1A7, 6A8, 12BE6, etc.).

If any of the voltages at these tubes is excessively low, check for continuity through resistors or coils to that particular element which reads low. Also check after opening the hot lead of any capacitor bypassing a tube element to ground. Internal shorts (within tube envelope) may cause excessive current drain and will drop plate and possibly screen voltages. If circuit elements check OK, try new tubes. As a matter of fact, if element voltages are low, but not zero, try new tubes first.

Other Tests

All grid voltages should read zero volts or less. If any is much over zero (positive voltage), check the coupling capacitors by opening them and re-reading the grid voltage. In most cases (audio power amplifier especially), a leaky or shorted coupling capacitor will throw "B+" onto the grid. Replace faulty coupling capacitors with good ones.

Resistance readings from the tube cathodes to "B+" should be low, on the order of 1000 ohms or less—300 ohms or less in r.f. stages. If any are high, check for open or increased value cathode resistors or coils in the case of the converter stage.

Grid-to-ground resistance readings should be high; from 250,000 ohms up, but not open. Suspect any grid which indicates over 1 megohm. Use manufacturers' data as guide for both cathode and grid resistance measurements since many sets have circuit peculiarities in this respect. Trace out grid lines where the resistance is low. Pay special attention to the grid socket terminal, for short to ground.

Cathodes should read zero or a few volts positive (say, up to 10 volts) when measured to "B—". If there are troubles here, resistance checks should isolate them.

With the exception of the oscillator grid (the one closest to the cathode in the converter tube), grid voltages should be close to zero. The oscillator grid will have a fairly high negative voltage of from —5 to —20 volts if the oscillator is functioning correctly.

Caution: In a series heater string, extreme care should be taken to avoid shorting a heater connection to "B—". Mentioned previously, this is repeated here to remind service technicians that even a momentary short will cause excessive heater current drain in some of the tubes. In the case of low-voltage tubes this might mean instant burn-out. —30—

Tape Recording

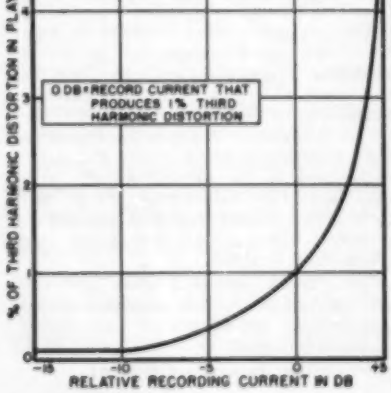
(*Continued from page 47*)

Tape has two important magnetic properties termed retentivity (B_r) and coercivity (H_c). These can be explained by reference to Fig. 1, which shows how the magnetic induction (B) in the tape varies with magnetizing force (H). Retentivity is the induction that remains in the tape after it is saturated and the magnetizing force then returned to zero. In order to reduce this induction to zero, a magnetizing force equal to H_c is required. This is termed coercivity. The values of B_r and H_c vary with the nature of the magnetic coating.

Large values of retentivity increase the tape's output, that is, its recorded induction, particularly at low and mid-range frequencies. At high frequencies increases in retentivity produce little effect. Instead, coercivity becomes the governing factor because it represents the tape's ability to resist certain losses, described later, that increase with rising frequency. Thus it may be stated that high-frequency response is governed largely by coercivity and low frequency largely by retentivity. The relationship between high- and low-frequency response is therefore related to the ratio of coercivity to retentivity. To a substantial degree, the ability of tape recorders to achieve wide frequency response at slow speeds is due to the fact that tape manufacturers have been able to increase this ratio, at the same time maintaining a high value of retentivity.

The relationship between high- and low-frequency response also depends upon thickness of the magnetic coating. Generally, a thin coating gives a relative improvement in high-frequency response. The recorded flux penetrates the coating to a greater

Fig. 2. Relationship of tape distortion to amount of record current at 400 cps. Data courtesy of Minnesota Mining & Mfg. Company. Figures based on the company's #111 tape, using a Brush head and optimum bias current. See article for details.



depth at low frequencies than at high ones. Therefore a thick coating has a more beneficial effect upon low frequencies. Conversely, a thin coating adversely affects the low frequencies and *in relative terms* improves high-frequency response.

At a given frequency and for a given amount of bias current, tape distortion rises with increasing record current, as indicated in Fig. 2. Eventually, as pointed out several paragraphs ago, an increase in recording current can saturate the tape. The relationship between record current and distortion is not linear, except possibly at very low levels. Once a level of 1 or 2 per-cent harmonic distortion has been reached, distortion accelerates rapidly with further rises in current. Hence it is better to err in the direction of recording at too low a level than at too high a level.

The level of record current that produces a given amount of distortion on the tape varies with frequency and tape speed, that is, it varies with recorded wavelength. For the standard tapes now in use, and at a speed of 15 ips, the permissible record current tends to be constant over part of the low and mid-frequency range. In the neighborhood of 2 kc. it begins to rise, until it is about 4 or 5 db higher at 15 kc. At the very low end it appears that permissible record current declines. In the case of a 7.5 ips recorder, the permissible increase of 4 or 5 db occurs at 7.5 kc.

Among the factors limiting the signal-to-noise ratio in tape recording is noise produced by the tape. Such noise takes two forms. One is tape hiss, previously mentioned. The other is "modulation noise," which appears only when a signal is recorded and varies with amplitude of the signal. Modulation noise is "developed" by the presence of a signal, whether a.c. or d.c. Therefore it is important to avoid any d.c. components extraneous to the audio information. These d.c. components may originate in asymmetrical erase or bias current or in a magnetized head.

Modulation noise is attributed partly to non-homogeneity of the magnetic coating and partly to the fact that the base material of tape is not perfectly smooth. Thus a tape with paper base, which is rougher than a plastic base, is characterized by greater modulation noise. Random irregularities in base thickness are accompanied by corresponding irregularities in coating thickness which, in turn, cause random variations in the magnetic characteristic of the tape. It appears, therefore, that application of an a.c. or d.c. magnetic field to the tape produces magnetic induction with similar irregularities. These irregularities in flux density are, in effect, an a.c. component corresponding to noise.

Next month we will delve into the problems of record and playback losses and discuss the effects of such losses on recorded quality.

(Continued Next Month)

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PLOTTING TUBE CHARACTERISTICS

By N. H. CROWHURST

TO UNDERSTAND how various tube circuits work in electronic applications, particularly in audio circuitry, one needs to visualize, in some manner or other, what happens to the tube under the various conditions of voltage applied to the different electrodes. With the complicated tubes now developed, this can become extremely difficult, and it is for this reason that a variety of methods have been adopted by engineers for plotting different kinds of tube characteristics on graph paper. These characteristics can be very impressive to the uninitiated, but taken in easy degrees they are really quite simple to understand.

Let us start with the simple triode type tube in which there is a filament or cathode, a grid, and a plate. The cathode emits a stream of electrons under the combined control of a negative grid voltage and a positive plate voltage. The grid serves as a sort of valve, permitting only a portion of the electrons through to the plate and forcing the remainder to return to the cathode. Those reaching the plate form the plate current.

To understand the behavior of a triode it can be connected in a circuit as shown in Fig. 1. Required are: a source of voltage to heat the tube's heater; a source of "B+" voltage; a source of negative grid voltage; two potentiometers, for controlling the grid voltage and plate voltage; voltmeters for measuring each of these voltages; and a milliammeter for measuring plate current.

When two of the three quantities, *i.e.*, grid voltage, plate voltage, or plate current, are varied, there will be corresponding variations in the third quantity. It is usual to regard variation of plate current as what mathematicians term the "dependent variable," because the electron flow, which appears in the external circuit as plate current, is controlled by the "independent" quantities, grid volts and plate volts. The only complete way to show the relations between three variables on one graph is to plot the graph in three dimensions, *i.e.*, cut it out of a solid, which becomes a little arduous! However, there is another method of presentation which is much more compact since it allows graphs to be plotted on normal squared paper instead of carving them out of solid material, and this consists of plotting a series of curves, each of which has one of the quantities fixed at a specified constant value.

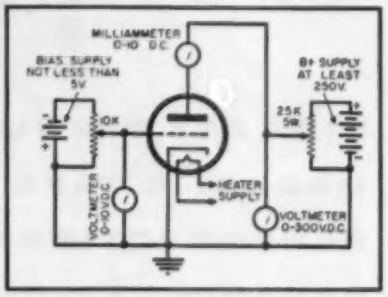
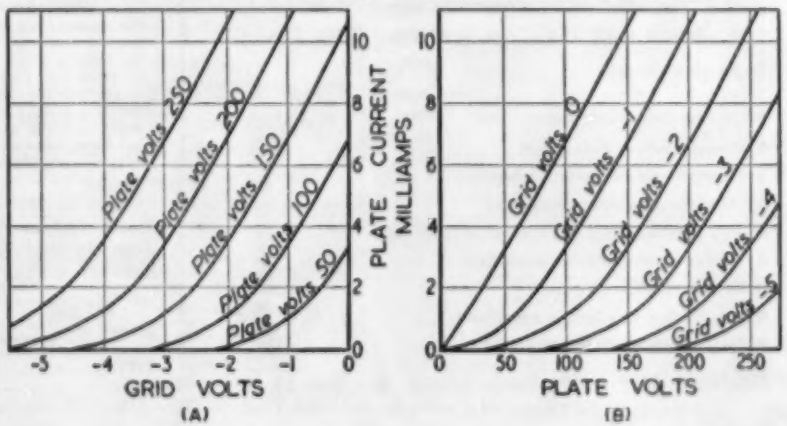


Fig. 1. Circuit to be used in obtaining characteristic curves of a triode tube.

Fig. 2. Two different ways of plotting the characteristic curves of a triode, using the circuit of Fig. 1. Refer to author's discussion of these methods in article.



For instance, the plate voltage may be set at a fixed value of 250 volts. The grid voltage can then be varied, values of current being plotted for grid voltages of 0, —1 volt, —2 volts, —3 volts, and so on to produce the first curve on the graph paper. The plate voltage would then be lowered to, say, 200 volts, and a second curve plotted in the same way. Further curves would be plotted, holding the plate volts constant at 150 volts, 100 volts, and 50 volts, respectively. This method would result in the "family" of curves shown in Fig. 2A. This is a familiar form of characteristics presentation for a triode.

These curves, however, are of limited usefulness, because in practice we use circuits where plate voltage as well as plate current change when the grid voltage is changed. However, for certain applications the plate voltage of a tube is kept practically constant so that the plate current is the only quantity to vary when the grid voltage is varied. In such a case the characteristics represented in Fig. 2A can be quite useful. Of course, a different set of curves could be plotted using the same method, but connecting a resistance between the "B+" supply voltage and the plate. This procedure soon gets complicated because, for one thing, a different set of curves would have to be plotted for each resistance value used, and secondly, the question as to where to plot values of plate voltage as well as plate current on the graph paper. We are using the vertical rulings to represent grid voltage so the horizontal rulings of the graph paper can only conveniently represent either plate current or plate voltage.

These complications can both be overcome by utilizing a completely different method of plotting the tube characteristics. To make the curve of Fig. 2A, the plate voltage is held constant at one value after another and then a curve is plotted for each representing plate current variation with varying grid voltage. In the alternative method, the values of grid voltage are held constant first at zero, then at —1 volt, then at —2 volts, and so on. At each value of grid voltage the plate voltage is varied and measurements are taken of corresponding plate currents. This produces the family of curves shown in Fig. 2B.

To illustrate how these curves are related one to the other the two groups of curves have been redrawn in Fig. 3 with points that correspond on the two sets of curves identified by small corresponding numbers. In the group of curves in Fig. 3A a particular value of grid voltage is represented by a vertical straight line while in the Fig. 3B group of curves the same value of grid voltage is represented by one of the curves. Thus points 1, 2, and 3 are all at a grid voltage of zero on both diagrams, and points 8, 9, 10, 11, and 12 are all at a grid voltage of —2. In Fig. 3B, on the other hand, a particular value of plate voltage is represented by an upright straight line

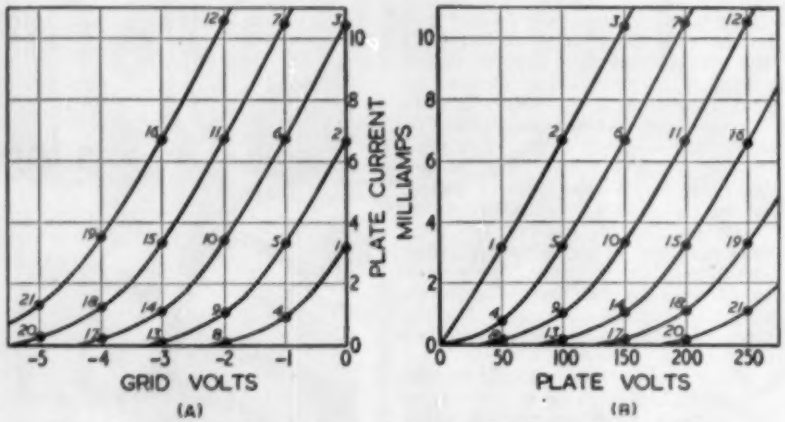


Fig. 3. The curves of Fig. 2 redrawn with numbered points to aid in identifying the same operating conditions on each set of curves. Method discussed in text.

while in Fig. 3A it is represented by one of the curves. Thus points 7, 11, 15, 18, and 20 are all at a plate voltage of 200 on both diagrams. The reader can trace out other points on both graphs for himself to see that each numbered point represents the same operating condition in the tube on both sets of curves. In fact, one set of curves could be constructed from the other.

Now we come to the particular usefulness of this second method. This derives from the manner in which we can apply what is known as a "load line" to the plotted characteristics. Suppose we have the simple direct-coupled circuit as shown in Fig. 4. We have a "B+" voltage of 250 and the tube plate is connected to the "B+" voltage through a coupling resistor of 25,000 ohms. If the tube does not pass any plate current, there will be no current through the resistor and the plate voltage will be the same as "B+", 250 volts positive from the cathode. But suppose the tube draws 10 milliamps: there will then be a voltage drop of 250 volts in the 25,000 ohm resistor, so its bottom end will be 250 volts negative from "B+" which is the same potential as the cathode, *i.e.*, the plate voltage is zero. If the tube draws, say, 4 milliamps, there will be a drop across the plate resistor of

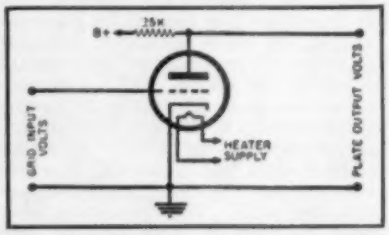


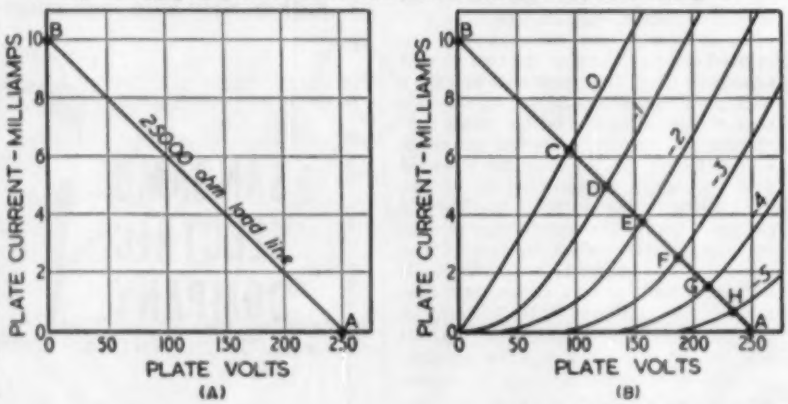
Fig. 4. Circuit of a simple direct-coupled stage showing how the curves may be used.

100 volts, leaving the plate at 250—100 = 150 volts positive from the cathode.

A lot more different values of plate current could be assumed and corresponding plate voltage could be calculated using this particular value of plate coupling resistor, but they will all be found to connect up in the straight line shown in Fig. 5A. This means that whatever happens in the grid circuit, or irrespective of the characteristic curves, the plate voltage and current must be represented by some point along this line, because of the voltage drop occurring in the 25,000 ohm resistor from the 250 volts "B+". For this reason such a line is called a "25,000 ohm load line."

In Fig. 5B the curves of Fig. 2B are redrawn and the 25,000 ohm load line

Fig. 5. Applying a load line to represent the 25,000-ohm resistor of Fig. 4.



What is the best amplifier?

THAT'S simple. The one that gives you the least distortion at high frequencies. Or put it this way: an amplifier with Unity Coupling. Because with Unity Coupling, transformer-caused impulse distortion just can't happen.

And which amplifiers *have* Unity Coupling? That's simple, too. National's Horizon 10 and Horizon 20.

You know what makes a conventional amplifier sound "raw"—especially at higher frequencies—even though its *harmonic* distortion may be rated low? It's because the output transformer has to function as a coupling device between output tubes.

But with a National Horizon, no rawness—ever. Unity Coupling takes over. Output transformer merely provides an impedance match between tubes and load.

So, impedance ratio of output transformer is lowered, leakage inductance cut way down. Power bandwidth naturally increases. More distortion-free power becomes available at higher frequencies. Which, of course, is exactly what you're after.

That's the logic of it . . . but even more convincing is the listening. National's Horizon amplifiers can be found only at authorized National Company full-line distributors.

SPECIFICATIONS

	HORIZON 20	HORIZON 10
Harmonic Distortion	Less than .3% at rated output of 20 watts	Less than .5% at rated output of 10 watts
Intermodulation Distortion	Not more than 1% at 20 watts	Not more than 2% at 10 watts
Frequency Response	20 cps—20 kc ± .1 db; 10 cps—100 kc ± 1 db	20 cps — 20 kc ± 1 db
Power Response	20 cps—20 kc ± .15 db; 10 cps—60 kc ± 1 db at 20 watts	20 cps — 20 kc ± 2 db
Sensitivity	1.6 volts for 20 watts output	.5 volts for 10 watts output

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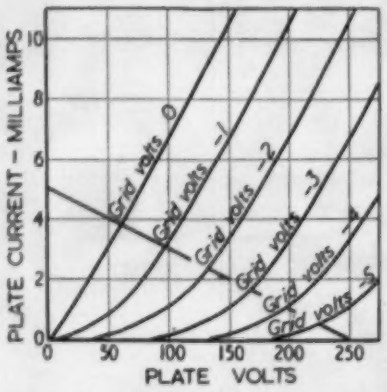


Fig. 6. Graph showing how a different load line may be drawn on same set of curves.

is drawn on top of them. Now suppose that the grid voltage is −1. The combination of plate current and plate voltage must be somewhere along the curve marked grid volts −1, but it must also be somewhere on the load line *AB* because this represents the only possible combinations of plate voltage and plate current with the particular value of coupling resistance shown in Fig. 4. So the actual value of plate voltage and current is easily identified by point *D* in Fig. 5B, as about 120 volts and 5 milliamps. In a similar manner other points along the load line, where the grid voltage curves cross it, lettered *C*, *E*, *F*, *G*, and *H* give the plate voltage and current for the grid voltage represented by each curve using this plate resistor and "B+" voltage. Thus the behavior of the tube for any particular plate coupling resistance can easily be worked out by drawing a load line across the characteristic curves representing the value of resistance chosen. Suppose, for example, instead of 25,000 ohms, we had chosen to draw a load line at 50,000 ohms. This is shown in Fig. 6, where the curves are repeated once again, and a load line is drawn to represent a resistance value of 50,000 ohms from a "B+" of 250 volts.

The simplest way to draw a load line is to calculate what current will pass through the resistor if the plate is imagined to be short circuited to ground, *i.e.*, what current will flow through the resistor with the full "B+" across it? In the case of the 25,000 ohm resistor 250 volts will cause 10 milliamps to flow. In the case of the 50,000 ohm resistor it will only cause 5 milliamps to flow. These points, 250 volts for "B+" on the plate voltage scale, and 5 or 10 milliamps, as the case may be, on the plate current scale, are connected together to form the requisite load line.

Thus it is seen that any number of load lines can be drawn on the same set of tube characteristics, when the tube characteristics are presented in this particular way, simply by drawing a pencil line across the published curves for the particular tube used.

—30—

correction voltage is then applied to a d.c. amplifier system that runs negative with respect to ground in order to have a negative-going bias that will vary between zero and minus 25 volts on the grid of the 6BQ6 (or 6CU6), a husky tube type needed to handle the relatively heavy current required for control of a saturable reactor.

A saturable reactor is a device in which one winding will control the inductance of a second winding. The reactor is placed in series with the motor which drives the color wheel. If the d.c. in the primary increases, the inductance of the secondary decreases, allowing more current to flow, and the motor to speed up, and *vice versa*. The motor itself is fed from an autotransformer which steps up the line voltage 25 volts or so, because even with the minimum inductance of the type reactor to be described in this article, there will still be considerable voltage drop. The circuit used for this portion of the converter is shown in Fig. 5.

The saturable reactor shown in Figs. 5 and 6 uses readily-available transformers. Four TV type (six would be even better) vertical output transformers of the kind which have individual primary and secondary windings work very well. The autotransformer types are not satisfactory. It is of the utmost importance that the transformers used be matched, *i.e.*, of the same manufacturer's part number. The reason is that the a.c. which will be induced in the primary winding (the d.c. control winding in this case) in each transformer must be canceled out by its mate. Connect all of the secondaries in parallel and pay close attention to the winding directions to make certain that all are the same. (For example, for RETMA coded units, connect all green leads to green, and yellow to yellow.) The primaries are all connected so that the pairs are series-opposed to a.c., *i.e.*, connect the red lead of transformer T_3 to its mate's (T_5) red lead, and connect the two blue leads to the next pair of transformer's blue leads. After the paralleled secondaries are connected in series with the motor and a.c. is applied, no, or very little a.c. voltage should appear between the ends of the combined primaries.

Caution: If an a.c. voltage of any magnitude *does* appear, recheck connections. The direction of d.c. to the primaries makes no difference as they are merely connected between "B+" and the plate of the 6CU6 control amplifier.

Incidentally, when using the 6AR8's in the color switching system, it is advisable to do away with the individual color amplifiers in the color chassis described in the color converter article in the December, 1954 issue of RADIO & TELEVISION NEWS, as the gain of the 6AR8's is rather high and makes

the amplifier unnecessary. Too much gain may cause instability.

The output from the Y amplifier should be disconnected from the matrix resistors and fed directly to the grid of the CRT. The color signals go to the cathodes and are matrixed within the picture tube.

The color wheel itself should have any multiple of 3 sections (6, 9, etc.) However, for projection use in front of the corrector lens, a 3-section wheel about 16" in diameter is best. Such a wheel gives longer useful projection time for each color without overlap of individual colors. The speed of the wheel is easily determined as a single section should cover the lens during one vertical field time, i.e., a three-section wheel should run 1200 rpm, a six-section wheel 600 rpm, etc. These speeds are a close approximation to those actually required because during a color broadcast, the field frequency is not quite 60 cycles. It may be desirable to drive the color wheel by means of a small V-belt drive, preferably fitted with one variable pitch pulley in order to bring the wheel close enough to the proper speed so that the automatic control system takes over.

It may be necessary to try different keyer amplifier outputs for the phase detector so as to get the "crossover" point into retrace. Try first one and then the other, and settle for the one which moves the "crossover" bar out of the visible portion of the raster.

It is strongly urged that fully saturated color filters *not* be used on this projection system. Doing so may reduce brilliancy. Instead, use ordinary-colored red, green, and blue Cellophane. Fasten these filters to a disc of clear plastic. Also, keep the weight of the wheel as low as possible in order to reduce any tendency for the automatic control system to "hunt." This is a difficult problem to correct and the heavier the wheel the more inertia there is to overcome, with the result that the wheel will overshoot the control, then slow down, then undershoot, then repeat the cycle.

Fortunately, there is an electronic circuit that may be used to correct for this defect. The suggested circuit is shown dotted in Fig. 4. The transformer is a vertical output type. It is important, of course, that the secondary be connected so as to give negative feedback. If it should be hooked up incorrectly, the d.c. amplifier will probably motorboat at a very slow rate that may be varied by turning the "anti-hunt" control (500,000 ohm pot). This circuit works on the idea that the rate of change of the correction voltage must agree with all the variables in the system, including weight of wheel, etc. The transformer only has an output when the current to the reactor is changing, and this output is directly proportional to the rate of change. The 500,000 ohm control taps off the amount of voltage necessary to properly control this change rate. In short, "anti-hunt" is time-controlled inverse feedback. —30—

What's New in Radio

TUBE ADAPTER

A. L. Products, Inc. of 311 Hickory Street, Kearney, New Jersey has developed a unique adapter unit which has been especially designed to simplify the work of the electronic, radio or TV engineer, the technician, and experimenters.

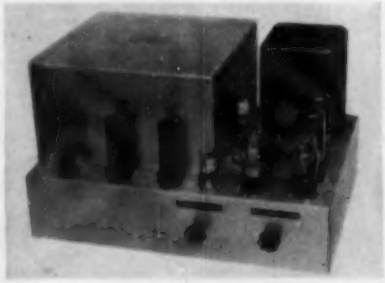
The new adapters are compact, high efficiency units which have been made as compact as possible for use in crowded chassis. The adapter is inserted into the vacuum tube socket and, in turn, the tube is plugged into the adapter to become an integral part of the circuit.

The unit may be used as an ordinary adapter for making test measurements of circuit voltages and resistances. To break into any tube circuit, the connecting rod which passes through the sleeve is pulled up until the rod is disconnected from the low sleeve. In this position the component or meter may be inserted into the circuit by means of alligator or any suitable clips. The terminals are color coded to aid in the checking process.

The company will supply full details on this adapter upon written request.

D.C. POWER SUPPLY

Spellman Television Co., 3029 Webster Ave., New York 67, N. Y. has developed a regulated, continuously variable 20-40 kv. d.c. power supply for use with 5AZP4 and 5TP4 projection tubes and flying spot types.



The Model RG-40 has a positive polarity output with a negative ground. Regulated focus is 4-8.5 kv. High voltage connections are provided through molded plug-in connectors. Dimensions are 17" wide x 13" deep x 10" high. For mounting this unit, a 19" x 10½" rack mounting panel is available.

PHOTO FLASH KIT

Illinois Condenser Co., 1616 N. Throop Street, Chicago 22, Illinois is currently marketing an electronic photo flash kit as the "Illini-300."

The unit is economical to build and operate, uses standard battery types, and provides 100 watt-second output from its 300 volt operating range. The 1/600 of a second flash duration is sufficiently short to stop practically any required motion yet is sufficiently long to achieve greater film effect than higher voltage units, according to the company.

The kit comes complete except for batteries. Simplified instructions and pictorial diagrams are included so that even inexperienced persons can assemble the kit.

For full information on this kit and the various available accessory units, write the company direct or contact your nearest photo supply or electronics parts distributor.

NEW SHIELDING MATERIAL

A new material which is said to embody an entirely new and different approach to magnetic shielding is now being manufactured by the Magnetic Shield Division of *Perfection Mica Company*, 1322 North Elston Ave., Chicago, Ill.

Because of its unique shielding properties, the new product has a diverse number of applications. It may be used as a shield for color TV, photomultiplier, and CR tubes, and magnetron and magnetic shipping and storage containers, transformer and coil cases, motor shields, deck plates and chassis, weather radar panels and dust covers, tape recording storage cases, magnetic switch shields, and as screen rooms.

The material can be fabricated into

a variety of shapes and sizes. For full details on this magnetic shield product, write the company direct.

DOT GENERATOR

Triplett Electrical Instrument Company of Bluffton, Ohio is in production on a new dot generator which has been designated as the Model 3438.

The new instrument checks video, r.f., i.f., sync, and color circuits with modulated r.f. (channels 2 to 6) and i.f.

(20 to 55 mc.) output available. Horizontal sync pulses and vertical sync pulses are available for checking sync circuits. Other features of the unit include horizontal bars (480 to 600 cycles) and vertical bars (crystal controlled at 189 kc.) for checking linearity on black-and-white and color sets. Crosshatch is used to check over-all linearity with 11 vertical bars and 8 horizontal bars. A square block will be produced for the crosshatch pattern.

The unit is completely self-contained. It is housed in a metal case measuring 6¼" x 11-1/32" x 15-11/32". Power supply is 115 volts, 50-60 cycles a.c. Power consumption is 55 watts.

PC SELENIUM RECTIFIERS

A new line of selenium rectifiers for use with printed circuits has been announced by *Federal Telephone and Radio Company* of Clifton, New Jersey.

Employing three different types of terminals, the rectifiers are designed for insertion into the printed circuit automatically or manually. The new rectifiers were developed especially for the radio and television industry where automation and printed circuit techniques are becoming increasingly important.

The three types of terminals available are: a square-tipped type for insertion into printed circuit boards up to 1/16" thick; a tapered type designed for ease of insertion by automatic equipment in printed circuit boards up to ⅛" thick; and a snap-in type which holds the rectifier firmly in place even when the circuit board is subjected to vibration or inverted prior to soldering.

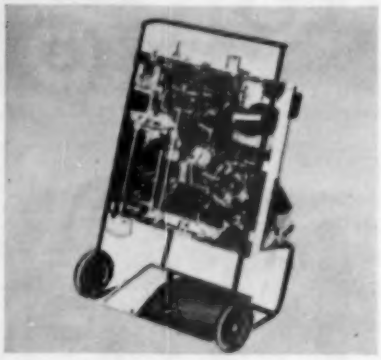
Full information on these rectifiers is available from the Components Division of the company at 100 Kingsland Road.

TV SERVICE AID

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Illinois has introduced

an ingenious device which is specially designed to aid television service technicians.

Known as the "Picto-Vue," the wheeled unit does double duty as a



chassis and tube service rack and truck. The unit can be used in the home or on the bench. It is ideal for moving a chassis and keeps it in a convenient position for working at the same time. An adjustable glass mirror at the bottom permits observation of the tube picture all during servicing.

In operation the technician sets the chassis on the rack, then tilts to working position, with no further handling required. For literature on this rack, write the company.

"REACTO-TESTER"

Anchor Products Co., 2712 W. Montrose Ave., Chicago 18, Illinois is now offering its Model T-400 "Reacto-Tester" to the service industry.

This compact instrument tests for open connections, open elements, useful life, shorted elements, cathode emission, and gaseous tube condition. The tube may be tested in the set, in its shipping carton, or on the bench. The unit will also repair open elements, correct shorts, and reactivate low emission tubes and restore brightness.

The tester measures 6½" x 9½" x 4¼" and weighs just 4½ pounds. The

meter is a 4½" full-view rectangular type. The company will forward a data sheet on this instrument upon request.

SOLAR BATTERY

National Fabricated Products, Inc., 2650 West Belden Ave., Chicago 47, Illinois is now manufacturing a solar battery under license from *Bell Lab-*

oratories and *Western Electric Company.*

Designed especially as prototypes for laboratory development work, these units develop up to 30 ma. of current for experimental purposes. The "batteries" may be connected in series or parallel to provide more usable amounts of power.

Further details on these devices are available from the manufacturer.

ETCHED CIRCUIT KITS

Keil Engineering Products, 4356 Duncan Avenue, St. Louis 10, Missouri has developed and is offering the designer, industrial worker, and experimenter two etched circuit kits which have been developed especially for experimental and prototype etched copper circuit work.

These low-cost kits include all essential chemicals and materials for processing. The "Professional" kit utilizes a photographic process to produce boards which are said to equal commercially prepared boards in quality. This kit features pre-sensitized, copper-clad phenolic sheets and materials for preparing negatives.

The "Standard" kit requires a manual application of the desired circuit on the copper-clad sheet. Pre-sensitized, copper-clad sheets of various sizes and processing materials are available separately.

For additional data on these kits, write the company direct.

PRINTED CIRCULAR TUBULARS

Cornell-Dubilier Electric Corp. of South Plainfield, N. J. has developed a new phenolic-encased plug-in paper

(*Continued on page* 157)

SELENIUM SALVAGE

SARKES TARZIAN, INC. is doing its part in overcoming the current selenium rectifier shortage by offering a ten-cent merchandise credit on each selenium rectifier turned in—irrespective of size or make.

The U.S. Department of Commerce is backing the drive because of the critical need for this component in military electronic equipment. All service technicians are asked to cooperate wholeheartedly in this effort to prevent a real crisis. —30—

NEW DX CONTEST OPENED

RADIO PRODUCTS SALES COMPANY, 1237 Sixteenth St., Denver 2, Colorado has announced a new Rocky Mountain Area DX Contest which will again be held in cooperation with various manufacturers of radio communications equipment and feature lavish merchandise prizes.

The contest, which began on August 31st will end at midnight (MST) on November 30th. Contestants must live in Colorado, New Mexico, Wyoming, Western Kansas, Western Nebraska, or Western South Dakota.

Contestants must register at RAPSCO either in person or by mail. Entry blanks, giving all the rules, will be furnished free of charge on request. Write today in order to have the maximum time in which to complete the required contacts. —30—

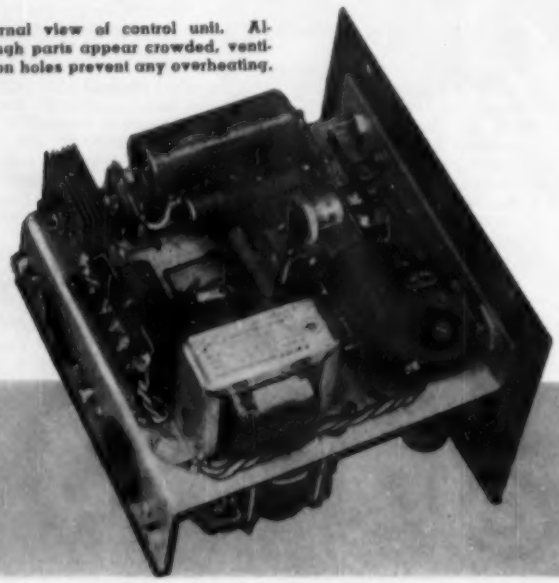
Temperature Control System

By **SAM D. BRESKEND**
Diamond Ordnance Fuse Laboratories

An over-all view of the temperature control unit with the sensing element, R_s, shown connected in place.

Basically, this unit can be used wherever temperature control within 1 degree, between −60 and 200 degrees C, is required. Its greatest application, however, is where extremes of temperature are to be controlled.

Internal view of control unit. Although parts appear crowded, ventilation holes prevent any overheating.



A TEMPERATURE CONTROL system was desired for the purpose of controlling the temperature of a small oven in which the properties of components, such as resistors and capacitors, are determined over the temperature range −60° to 200°C.

Bimetal thermostats that would cover this range would be bulky, combersome, and difficult to reset. An external relay would have to be used to prolong the life of the contacts on the thermostats and a time delay would be required to prevent excessive chattering at the controlled temperature. For these reasons, it was decided to build an electronic unit.

A unit which used either a thermocouple-type sensing element or a resistance element was desired because such a unit would be of the remote-controlled variety. The use of a thermocouple necessitated using either a chopper and an a.c. amplifier, or a d.c. amplifier capable of large gains and extraordinary stability. The resistance element, on the other hand, seemed to be the ideal choice. It could be wound to conform to any shape needed, and would also have the advantage of being separate from the main controller. This arrangement would make the system useful not only for controlling the temperature of an oven but also of any device into which the leads could be sealed.

The unit which finally evolved is shown in the photos. The schematic diagram of Fig. 1 illustrates the circuit used.

The sensitivity of a simple unit such as this is governed mainly by the temperature coefficient of the sensing element used. In this system, a nickel wire wound on a mica form was used. The temperature coefficient of nickel is .6 per-cent per degree C. With a nominal value of 60 ohms at 20°C (68°F), a change of 1°C in temperature is equivalent to a change of .36 ohm in resistance. The system described operated satisfactorily with a change of .2 ohm in the resistive sensing element.

The bridge is energized by the secondary of the filament transformer T_1. The output of the bridge is coupled to the grid of the amplifier through transformer T_2. The advantages of using transformer coupling are two-fold. First, the bridge and therefore the sensing element can be isolated completely from the a.c. line. Secondly, a voltage gain in transformer T_2 can be achieved.

The thyratron used to energize the relay is operated with a.c. on its plate, in order to have complete control of the tube's firing cycle by means of its grid. Since there is conduction through

the thyratron only when the plate is positive, it is imperative that the proper phase relationship be maintained between the signal voltage and the plate voltage. With the circuit components specified, phase shift was negligible. The theory of operation can best be illustrated by using elementary thyratron firing curves, Figs. 3A, 3B, and 3C. Fig. 3A shows how the signal voltage cuts off the thyratron when R_6 plus R_5 is much lower in resistance value than R_3. In Fig. 3B the combination of R_6 and R_5 is slightly lower in resistance value than R_3. The bridge has not as yet gone through a null but has reached a firing point. In Fig. 3C the combination of R_6 and R_5 is above the resistance value of R_3. The bridge has gone through a null, the phase of the signal has changed 180°, and the thyratron continues to fire.

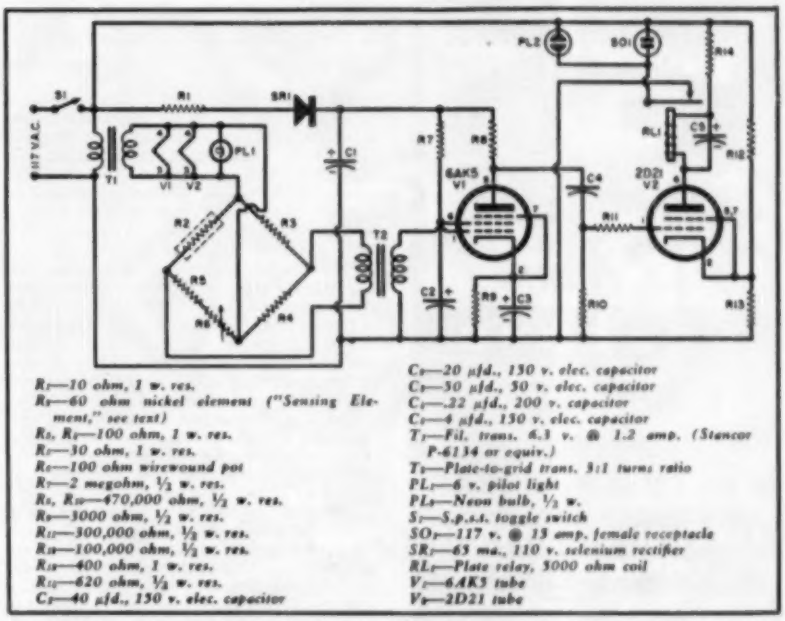
It can be seen that once the desired temperature has been reached, the resulting shift through the null in the bridge will cause a sufficiently negative signal, as in Fig. 3A, causing total cut-off in the thyratron and thus preventing runaway ovens. This would also happen if the sensing element opened accidentally.

Bias for the last stage is derived from the following combination: R_{13} and R_{12} across the a.c. line and contact bias developed across R_{10} plus R_{11}. This, in conjunction with the signal voltage, holds the thyratron at cut-off. With this method of bias, a relatively large signal is required to activate the thyratron. Therefore, a better signal-to-noise ratio exists about the control point than would exist at a signal null.

As previously mentioned, for proper operation it is important that the proper phase exist between the thyratron plate and the signal voltage on its grid. To determine the phase, the temperature control, R_6, is increased to its extreme position, calling for more heat. The pilot light, PL_2, which indicates that the heater is on, should be lit. If the proper phase does not exist, the bulb will go out. In this case it will be necessary to reverse the polarity of the signal voltage. This can be accomplished by reversing the primary conections on transformer T_2.

During the time this unit has been in use only one difficulty has arisen. When set for operation at elevated temperatures there is a tendency for the oven to overshoot. However, this is not a fault of the regulator. It is due, primarily, to the temperature lag inherent in the large heater used. To overcome this difficulty it has been necessary to bring the oven up to temperature in small increments. For example, if it is desired to go from an ambient temperature of 20°C to 100°C, it would be advisable to set the controller at 90°C, and only after the heater is de-energized at about 90°C should the unit be set for 100°C.

To overcome this difficulty it would be beneficial to devise some means of enabling the controller to apply heat in direct proportion to the amount needed. A simple way to accomplish this would be to install an anticipation circuit or proportional circuit of the required degree of complexity to function adequately.



R_1—10 ohm, 1 w. res.
R_2—60 ohm nickel element ("Sensing Element," see text)
R_3, R_4—100 ohm, 1 w. res.
R_5—30 ohm, 1 w. res.
R_6—100 ohm wirewound pot
R_7—2 megohm, ½ w. res.
R_8, R_{10}—470,000 ohm, ½ w. res.
R_9—3000 ohm, ½ w. res.
R_{11}—300,000 ohm, ½ w. res.
R_{12}—100,000 ohm, ½ w. res.
R_{13}—400 ohm, 1 w. res.
R_{14}—620 ohm, ½ w. res.
C_1—40 μfd., 150 v. elec. capacitor
C_2—20 μfd., 150 v. elec. capacitor
C_3—50 μfd., 50 v. elec. capacitor
C_4—.22 μfd., 200 v. capacitor
C_7—4 μfd., 150 v. elec. capacitor
T_1—Fil. trans. 6.3 v. @ 1.2 amp. (Stancor P-6134 or equiv.)
T_2—Plate-to-grid trans. 3:1 turns ratio
PL_1—6 v. pilot light
PL_2—Neon bulb, ½ w.
S_1—S.p.s.t. toggle switch
SO_1—117 v. @ 15 amp. female receptacle
SR_1—65 ma., 110 v. selenium rectifier
RL_1—Plate relay, 5000 ohm coil
V_1—6AK5 tube
V_2—2D21 tube

Fig. 1. Schematic of temperature controller. For circuit variations, see text.

To alter the range of the instrument from −60°C to 200°C to some other range, it is only necessary to change the values of the resistors in the bridge. Resistor R_6 can be changed so that balance can still be obtained with resistor R_6. However, for maximum sensitivity of a bridge, all arms should be equal. If difficulty is encountered in obtaining nickel wire, a good substitute is iron wire which also has a fairly high temperature coefficient of resistance. The disadvantages would be the susceptibility of iron wire to corrosion and a slight decrease in sensitivity at temperatures below approximately 70°C.

After calibration, no trouble should be encountered with resetability. However, should it become necessary to use extremely long leads to the sensing element, recalibration would be in order. Reasons for this are evident;

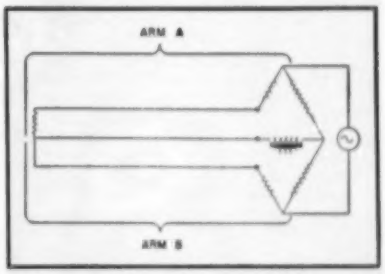
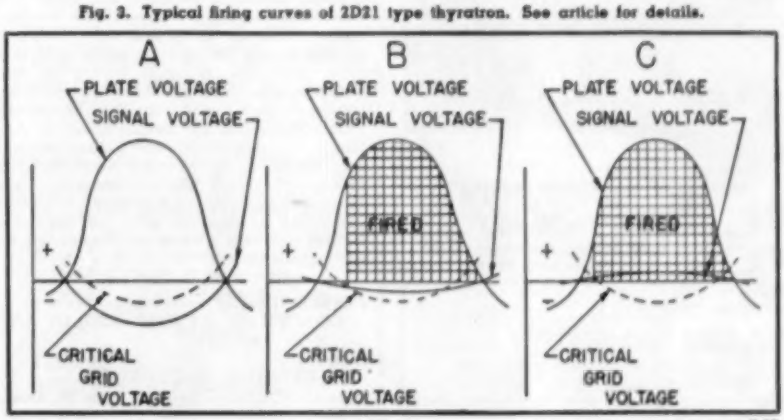


Fig. 2. Schematic diagram of three-wire connection to the sensing element, R_2.

lead length and hence lead resistance affect only one arm of the bridge, that which contains the resistance sensing element.

Fig. 2 illustrates a method whereby lead length and lead resistance are effectively cancelled. It can be seen that, for a given change in lead resistances, arm *A* and arm *B* change exactly the same amount, one nullifying the effect of the other. -30-

Fig. 3. Typical firing curves of 2D21 type thyratron. See article for details.



Certified Record Revue

(Continued from page 72)

thrilling new listening experience. There is much that will be totally unfamiliar to you and I am sure, that more than ever, you will be impressed with Ravel's extraordinary orchestration. This recording must inevitably be compared with the Ansermet version on *London*. Although this might seem to be a formidable task, in reality the resolution is quite easy. In matters of performance, there is very little to choose between Ansermet and Dorati. Both are expert in the ballet idiom, and one would have to be awfully picayune to point out any glaring defect or superiority of one performance over the other. Dorati essays a slightly faster pace than Ansermet and is meticulous in his attention to detail. Yet he does not become enmeshed in the intricacies of the orchestration and the performance is warm and in the smoothly flowing grace, the carefully chosen dynamics, the exquisitely modelled phrasing, is as opulently sensual as Ravel intended.

In matters of sound the issue is clear-cut. The *London* recording was and is, a superior job of engineering. But this recording can best be described as fantastic! From the soft shimmering strings of the opening bars, with the French horn sounding the theme in an impossibly high register, to the faint, offstage sussurrations of the strings and woodwinds, with the lovely solo flute now taking the theme, which is heard after the pirate Bryaxis seizes Chloe, to the bright blast of the trumpets, the sharp rap of the snares and the insistent punctuation of the tympani and the wild animation of the clarinets, the flutes and the piccolos and other woodwinds in the frenetic, blazing "General Dance" of the finale, this is the musical and hi-fi treat of the season!

The important choral work throughout the score is superbly handled by the Macalester College Choir of St. Paul. There are tremendous climaxes in this score and if you have the proper equipment, you will find they are quite free from distortion. The dynamic range is extraordinary and probably represents still another step forward in the recording art. I assure you that to fully reproduce this tremendous range, you need a system which not only has the power to handle the great peaks, but one that is dead quiet . . . no hum, no rumble, nothing which would override the incredible ultra-pianissimo which occurs in several places in the score. I urge you to listen to the quiet parts very closely, and you will realize that this is just as much a quality of superior hi-fi recording as the loudest drum blast.

Throughout the recording, all is extremely wide range in frequency, distortion is nonexistent, transients are sharp and clean. The orchestral balance and the balance between choir and orchestra is just right and is a notable feature in a work where this is a major problem. Acoustic perspective was somewhat more spacious than that which has previously been heard from the Minneapolis, which is justified by the score, but in any case it does not obscure inner detail and the over-all liveness and presence has to be heard to be believed! Truly, this recording is a major triumph for all concerned. I know this review is long, but after you hear this, I think you will understand the reason for my enthusiasm.

PROKOFIEV
CONCERTO #1 FOR VIOLIN AND ORCHESTRA
LALO
SYMPHONIE ESPAGNOLE
Nathan Milstein, violinist with St. Louis

Symphony Orchestra conducted by Vladimir Golschmann. Capitol P8306. RIAA curve. Price $4.98.

The Milstein/*Capitol* alliance has been most fruitful thus far, and on this disc is ample evidence to indicate a continuing flow of riches from this combination. The 7th reading of the Prokofiev work is the prize on this disc. Both in matter of superbly integrated performance of Milstein and Golschmann and superiority of sound, this wins hands down over the competing discs. Milstein threads his way through the difficult passages of the work with an ease and assurance born of long familiarity. His fingering is always deft and sure, his bowing ultra-precise. He produces a big glowing tone, yet he has the bite and the vigor when needed.

Golschmann is entirely sympathetic and maintains a splendid balance between orchestra and soloist. Sound here is very wide range in frequency and dynamics, beautiful clean string tone, bright punchy brass and sharply accurate percussion are plus virtues.

The Lalo work is also very well done, but seems subsidiary in face of the brilliance of the Prokofiev. Nicely phrased, carefully chosen dynamics, nice bright clean sound, the Lalo has all these but this writer still hews to the older Heifetz version as closer to the substance of the score. If you like brilliant modern violin concerti, you can't go wrong with the Prokofiev recorded here. Highly recommended.

MENDELSSOHN
SYMPHONY #3
CALM SEA AND PROSPEROUS VOYAGE

Israel Symphony Orchestra conducted by Paul Kletzki. Angel 35183. RIAA curve. Price $4.98. (Factory-sealed)

Here is another of the Israel Philharmonic's first batch of LP's, and while not as illustrious as their recording of the Mahler "9th" reviewed last month, is still a worthwhile item. Conductor Kletzki takes his Mendelssohn at a rather slow pace and, as a consequence, the performance is somewhat lacking in cohesion. His handling of phrasing and dynamics is most exemplary, but in paying attention to this and other details he has sacrificed warmth and expression. However, these falls from grace are not too serious and on the credit side of the ledger is the fact that this is certainly the best sounding Mendelssohn in the catalogue. The Israel Philharmonic plays superbly, and adds to the luster they achieved in the Mahler "9th." Their string tone is particularly smooth and quite sumptuous. The sound is of the "big-boned" variety . . . very heavy, very sonorous with exceptionally good dynamic range and notable lack of distortion. I would rate the symphony as the tops in sound and a close second to the Mitropoulos performance. The "Overture" can stand comparison, technically and musically, with any version in the catalogue.

MAHLER
SYMPHONY #8
Rotterdam Philharmonic Orchestra with soloists and the Rotterdam Choirs conducted by Eduard Flipse. Epic SC6004. NARTB (Old) curve. Price 89.96. Two discs.

This is Mahler's most epochal work, as might be inferred from the subtitle, "The Symphony of a Thousand." And indeed it takes vast resources to perform this monumental symphony. Naturally these requirements have severely limited the number of performances. To my knowledge the only performance of this work in fairly recent years in this country was in 1950 at Carnegie Hall under Leopold Stokowski. And as far as I'm concerned, it was the best read-

ing I have ever heard. But alas, and alack, unless *Columbia* has recordings of the work hidden in some secret vault, we have no recall of the Stokowski performance.

Such being the case, this recording of the Holland Festival performance is the best available. Its flaws and virtues are about equally distributed. The performance has much to recommend it and the choral groups do some excellent work. The orchestra strives nobly, but it is plain they are not the equal of their famous brothers of the Concertgebouw in Amsterdam. The sound is the major bone of contention, however. A decidedly uneven recording with some parts quite modern-sounding with good wide range and low distortion, other parts that sound very screechy and unbalanced, with a most noxious tubby bass being the worst offender. Admittedly a difficult work to record, the engineers must be given credit for maintaining a reasonable balance between vocal and orchestral elements. In spite of all deficiencies this is a far better recording than the older *Columbia* version, and since recordings of this work are very few and far between, it will serve those who would be enthralled with the power and the beauty of this supreme effort by the tragic Gustav Mahler. You'll have to play around with the equalization a bit. The old NARTB curve with the bass rolled off an extra few db and a slight cut in the treble sounded best in my set-up.

HOLST
THE PERFECT FOOL
BAX
TINTAGEL
BUTTERWORTH
A SHROPSHIRE LAD
THE BANKS OF GREEN WILLOW
London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL1169. RIAA curve. Price $3.98.

Here is a veritable bonanza for the anglophile music lover. The material is very interesting, especially the lovely Butterworth pieces. The "Perfect Fool" ballet suite and the programmatic "Tintagel" is the type of thing that appeals to the hi-fi fan and with some sensational sound to be found throughout these works, are sure to become demonstration favorites. The performances by the London Philharmonic and Boult will have to be regarded as definitive. Listen to "Tintagel" which depicts the castle-crowned cliff in the days of King Arthur, with the restless sea surging around its base. The orchestration here is vividly pictorial and the crash of the waves makes an almighty sound! The sound throughout all of these pieces is a prime example of *London's* best. Strings have a lovely smooth cleanness, the brass, especially in the "Perfect Fool" is sharply focused and extremely brilliant, percussion is notable for its impact and articulation, both the high stuff heard to advantage in the "Perfect Fool" and the solid whumps of tympani and bass drum in "Tintagel." Highly recommended.

BEETHOVEN
CONCERTO IN D MAJOR FOR VIOLIN AND ORCHESTRA
David Oistrakh, violinist with Stockholm Festival Orchestra conducted by Sixten Ehrling. Angel 135162. RIAA curve. Price $4.98.

After years when the art of the remarkable Oistrakh was available to us only on discs processed from incredibly bad Russian tape masters, discs like this one and a recent *Decca* Oistrakh made, come as something of a shock. If you really want to hear what this great virtuoso sounds like, take a listen to this recording. The *Decca* recording was the first inkling of how the Oistrakh violin sounds, but on this disc we can truly say

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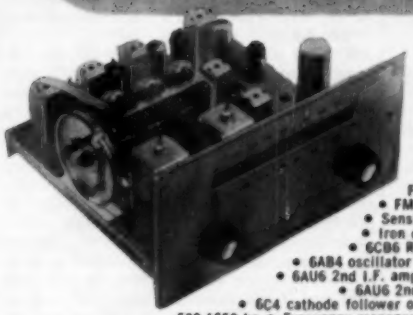

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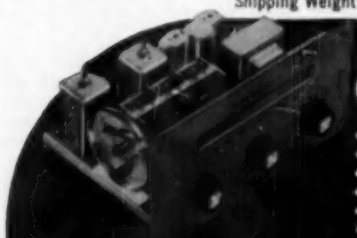

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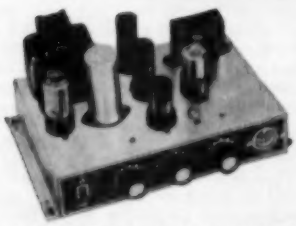

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that this represents the first time that Oistrakh has been recorded with modern high-fidelity techniques. What the *Decca* disc only hinted at is clearly revealed on this disc. The luscious, great fat tone, the incredible finger dexterity evident in his technique, the innate musicianship, with a trace of the showman for good measure, all are here for us to newly evaluate and at which to marvel.

Not much doubt about it, this Oistrakh is truly a violinistic phenomenon. This recording was made at the Stockholm Music Festival in 1954 and, fortunately for us, the Swedes have been well instructed in the use of tape and modern recording techniques, so we come up with a Beethoven "Violin Concerto" which must be adjudged as one of the most desirable. The orchestral sound is quite good, of the "big hall" type. Generally it is characterized by clean strings, bright brass, and some very live percussion especially the tympani. Oistrakh's violin is heard with exceptional clarity, never wiry but smooth and rich. The balance between violin and orchestra is sensible, the distortion is near vanishing, dynamic and frequency response is quite wide. Sixten Ehrling gives a creditable performance with a few mannerisms which can be annoying at times. With all due respects to Mr. Ehrling, the role of the conductor in an Oistrakh concerto performance is almost subsidiary and this incredible Oistrakh can make a concerto sound good even in the hands of the conductor of the West Podunk Philharmonic. Yes, there are flaws and blemishes in this recording, but once heard, this version has a powerful argument against most competition.

WARLOCK
CAPRIOL SUITE
SERENADE FOR FREDERICK DELIUS
IRELAND
MINUET
Boyd Neel String Orchestra conducted by Boyd Neel. London LD9170. RIAA curve. Price $2.50.

Another good buy in the low priced *London* "LD" series, this will have great appeal for those who like modern string works, and should be especially welcome to students. Warlock has gained some prominence with his "Capriol Suite," which has some breathtakingly difficult passages, especially the discordant final dance. His homage to Delius is a most ingratiating little work and has more substance than the title might indicate. Ireland's lovely little "Minuet" shows off the superb tone and wonderful precision of Boyd Neel's fine orchestra. The recording is notable in the clarity and cleanness of the strings and all is clothed in a very live acoustic environment. Try this for an offbeat excursion into the realm of the strings.

CHOPIN
THE FOUR BALLADES
Friedrich Gulda, pianist. London LD9177. RIAA curve. Price $2.50.

No one can accuse *London* of withholding its best artists from its popular low-priced "LD" series. Not when someone of the stature of Gulda is playing Chopin. The fourth recording on LP, this is easily the best. Gulda's only serious competition is Casadesus on *Columbia*, and if Casadesus has a somewhat broader insight of the works, he lacks the flashing technique and warmth of Gulda. Call it a toss-up if you will on matters of performance, but it's strictly no contest when it comes to sound. The *London* piano is big-toned, impressive in its rich sonorities. Frequency range and dynamics are very wide and transients are reproduced with no ringing or other distortion. Wow and flutter, even in the inner grooves was nil. A superb pianist in a superior recording of some of Chopin's most original and interesting music for piano. Recommended.

BACH, J. S.
TOCCATA AND FUGUE IN D MINOR
PRELUDE AND FUGUE IN F MINOR
Robert Noehren, organist. Audiophile AP-9. AES curve. 78 rpm microgroove. Price $5.95.

Readers with sharp eyes have already detected something different in the title above. Yes, it means what it says . . . this recording can only be played at *78 rpm* speed with your .001 microgroove stylus. The engineer of this disc, the astute Mr. E. D. Nunn claims this combination is the best for wide range and low distortion. A hearing of this and other of his *Audiophile* records seems to justify his contention. This is really super-sound . . . sound that can only be produced by someone devoted to the highest standards of recording practice and with enough time and indifference to commercial realities to worry over every record. Mr. Nunn has used the baroque style instrument in the Grace Episcopal Church in Sandusky Ohio, to record these well known Bach works.

Noehren gives an excellent performance, using the baroque registrations intelligently. His familiarity with this organ is most helpful and stems from his recording association with the now-defunct *Allegro*, who used this organ quite regularly. The organ is exceptionally clear-voiced and in the ultra-wide range frequency response engraved by Mr. Nunn, it is quite easy to hear the artist's attacks and holds, his degree of pressure, and the characteristic "breathiness" and "reedy" sound of the higher stops. The pedal line is very clean and distortionless and goes down to some respectably low frequencies, but lovers of the low, low pedal will not find it here. The baroque instruments were not voiced and do not have the power necessary for the production of 16 and 25 cycles. Nevertheless, this is a very thrilling organ sound and will probably be appreciated and bought by organists themselves.

JOSH WHITE 25TH ANNIVERSARY ALBUM
Elektra 701. RIAA curve. Price $9.96. Two discs.

This contains the story of "John Henry" and "Ballads," blues, and other songs that have become associated with Josh White over the past 25 years. As a minor compendium of his talent, it is well done and very worthwhile. What can you say about Josh? You either are crazy about him or completely indifferent. For his many fans, this will be a treat, not only for his material and his wonderful way with it, but for the superbly clean recorded sound. Properly close-up and intimate, this, as played through a good system in a living room, really justifies the term "presence." Highlight for me is Josh's hilarious rendition of "Free and Easy Blues" which spoofs as he puts it "scientific talk-talk" (or double talk). A wonderful album which I intend to enjoy on numerous occasions in the future.

RCA still has not come across with their new tapes, so still nothing to report from that front. *Positively* next month says their PR man. Well, I'm awaitin'.

See you at the Audio Fair. —30—

Electronic Counter

(*Continued from page 62*)

both of which are low. Since the difference in voltage between H and L is sufficient to light the lamp, number 0 ignites. On the count of one the B end of lamp 1, which is connected in parallel with the B end of lamp 0, again is low. The A end of lamp 0 is now low and the A end of lamp 1 is now high since V_1-V_2 has flipped; therefore lamp 1 ignites, lamp 0 extinguishes.

Checking on the condition of the other lamps during this period it is seen that lamps 2 and 3, which are connected in parallel and to tubes V_3 and V_4 are both out. This condition obtains because during count zero and one the plate of V_3 is high and the plate of V_4 is low, resulting in a voltage at the B end of these two lamps which is the arithmetical mean of the two voltages.

In the circuit under consideration the voltage corresponding to H is 120 volts and the voltage corresponding to L is 60 volts. The resulting voltage at the B end of a lamp connected to one H and one L voltage is, therefore $(120 + 60)/2 = 90$ volts. Since the A end is either 60 or 120 volts, and 60 volts is required across the terminals of a lamp to ignite it, a lamp will not light under these conditions. Checking the remainder of the lamps during count zero and one, lamps 4 and 5 are in parallel and connected to V_5 and V_6. Since V_5 is high and V_6 is low the voltage at the B end of these lamps is 90 volts and they will not ignite. Lamps 6 and 7 are connected in parallel and to V_7 and V_8. They also will not light during count zero and one for the same reason as the previous lamps. Lamps 8 and 9 are connected to V_8 and V_7 and since both tubes are high during this interval these lamps will not light. Continuing on for the rest of the counts, with the aid of the chart, will show that this circuit arrangement will result in the proper operation of the decimal counter.

An experimental decimal counter is shown in the photograph and the schematic diagram of Fig. 6. The dimensions of the case are 4¼" x 5¼" x 1½". The ten neon lamps are mounted behind a fiberboard sheet into which ten circular windows have been cut, covered with celluloid and numbered from 0 to 9. The terminal board consists of a 3" x 4" x 1/16" fiberboard sheet into which holes have been drilled to provide a means for supporting and interconnecting components on both sides of the board. Due to the large number of resistors and capacitors, considerable care in laying out the unit is necessary. The components are mounted in as symmetrical an arrangement, consistent with short leads, as possible; and the terminal board is completely wired before mounting in the case. The connections to the tube sockets, with the exception of the heat-

ers and cathodes, are wired after the terminal board is fastened to the chassis. All resistors are ½ watt carbon except the common plate loads and the cathode resistor, all of which are 1 watt. All capacitors are mica except the cathode bypass, which is ceramic.

The power requirements of the unit are 225 to 300 volts at 12-15 ma. and 6.3 volts at 1.2 amperes. Negative input pulses or square waves, with relatively steep leading edges, 75 to 100 volts in amplitude, are required to drive the unit. The output is a square wave of the proper amplitude and waveshape to directly drive a second similar unit. —30—

The "Minipak #1"

(*Continued from page 67*)

Construction Hints

Follow the schematic faithfully when reproducing the "Minipack" circuit. Use identical component values as given in the parts list, or you'll wind up cussing the designer.

Don't substitute any resistance or capacitance values or the circuit will refuse to function properly. The voltage divider values are quite critical, but you can employ large tolerance resistors without encountering trouble.

Don't eliminate C_5. Without it, the lonely little ripple volt can't find its way back to V_1's control grid, having a rough time of it through R_5 and R_6. This would result in ripple on the output voltage, which means *hum* in the converter or v.f.o.

Put R_1 and R_2 in series with the plates of their respective gate tubes. If omitted, the circuit most likely will oscillate.

Don't try to pull more current than is called for by the design.

Don't worry about heater-cathode voltage breakdown within the tubes. The "Minipack" was built over two years ago and has been running almost daily since it was initially fired up, supplying beautifully regulated "B plus" to a 12-tube, two-meter superheterodyne receiver. Haven't replaced a tube yet!

Try building this electronically-regulated supply. It can result in more efficient performance of your ham or experimental equipment. —30—

LONG ISLAND HAMFEST

THE Federation of Long Island Radio Clubs is holding its annual hamfest on Friday evening, October 14th, at Lost Battalion Hall, 93-29 Queens Blvd., Elmhurst, Long Island, N. Y.

The affair is scheduled to start at 8 p.m. The program includes exhibits, music for dancing, and general get-together for chewing the rag.

Tickets are $2.00 if purchased in advance or $2.50 at the door. Write to Robert I. Lippman, secretary of the Federation, at 30-51 Hobart St., Woodside 77, Long Island.

The ten clubs comprising the Federation extend a cordial invitation to all hams to attend. —30—

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President

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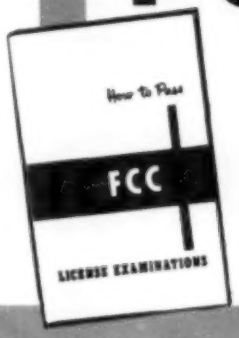

FREE

Tells where to apply and take FCC examinations, location of examining office, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examination.

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TV ENGINEERING INCLUDED IN OUR TRAINING & COACHING

TELLS HOW

WE GUARANTEE YOUR FCC LICENSE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET YOUR FCC LICENSE.

If you have had any practical experience—amateur, military, radio repair, experimenting, etc.

HERE IS YOUR GUARANTEE

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind, until you successfully obtain your Commercial license.

THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

Your FCC ticket is recognized by employers in all phases of Electronics as proof of your technical ability.

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Here are a few recent examples of Job-Finding results.

ELECTRONICS TECHNICIAN:
"I am now employed by the Collins Radio Company as a Lab Technician. (This job was listed in your bulletin). I have used the information gathered from your course in so many ways and I know that my training with CIRE helped me a great deal to obtain this job."
Charles D. Sindelar,
Cedar Rapids, Iowa

AIRLINES
"I replied to the Job Opportunities you sent me and I am now a radio operator with American Airlines. You have my hearty recommendation for your training and your Job-Finding Service." James A. Wright, Beltsville, Md.

INDUSTRIAL ELECTRONICS
"Upon my discharge from the Navy I used your Job-Finding Service and as a result I was employed by North American Aviation in electronic assembly (final checkout)." Glen A. Furlong, Fresno, Calif.

TELLS HOW Employers make JOB OFFERS Like These To Our Graduates Every Month

Broadcast Station in Illinois:
"We are in need of an engineer with a first class phone license, preferably a student of CIRE; 40 hour week plus 8 hours overtime."

West Coast Manufacturer:
"We are currently in need of men with electronics training or experience in radar maintenance, and we would appreciate if you will refer interested persons to us."

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME.

	License	Time
A/1C Ronald H. Person, St. Louis 20, Mo.	1st	25 weeks
Carl Verboomen, Wrightstown, Wis.	1st	18 weeks
Marvin F. Kimball, Lafayette, Ind.	2nd	21 weeks
L. M. Bonino, Harlington AFB, Tex	2nd	16 weeks
John E. Hutchison, Bluefield, W. Va.	1st	27 weeks

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Find out how your FCC License will be your guarantee of a bright future and employment security in all branches of Electronics—the world's fastest growing industry!

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Harry G. Frame, Charleston, W. Va.	2nd Class	13 weeks
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Omar Bibbs, Kansas City, Mo.	1st Class	34 weeks
Kenneth Rue, Dresser, Wisconsin	2nd Class	20 weeks
B. L. Jordan, Seattle, Washington	1st Class	20 weeks

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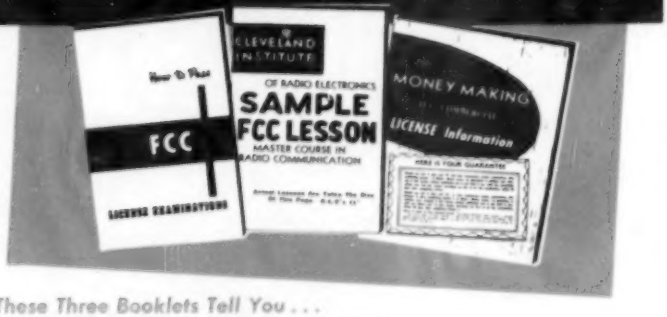

These Three Booklets Tell You . . .

1. **Where to apply to take FCC Examinations.**
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4. **Positive knowledge check.**

And additional data of great value.

IMPORTANT
SEE OTHER SIDE FOR MORE INFORMATION

HERE IS YOUR GUARANTEE

WE GUARANTEE to train and coach you at home until you pass the all-important FCC examination . . . If you fail to pass after completing our course, we will continue your training without additional cost until you successfully obtain your commercial license.

THROUGH US—START BUILDING FOR A PROFITABLE LIFETIME PROFESSION.

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EMPLOYERS MAKE JOB OFFERS EVERY MONTH!
YOUR FCC TICKET IS RECOGNIZED BY MOST EMPLOYERS IN THE ELECTRONICS FIELD AS PROOF OF YOUR TECHNICAL ABILITY.
PAVE THE WAY FOR YOUR SHARE OF THE BETTER THINGS IN LIFE.

If You're in the Armed Forces PLAN NOW for

PRESENT and FUTURE SECURITY

1. **Use your spare time, NOW, while you are in the armed forces, to prepare for the FCC license examinations, and get your FCC Commercial License.**
2. **Shortly before discharge, use our EFFECTIVE JOB-FINDING SERVICE to get your choice of good-pay jobs.**

Special tuition rates to members of the U. S. Armed Forces.

NORTH AMERICAN EMPLOYS EX-ARMY MAN

"I am employed by North American Aviation as an electronic technician. Their name was received from you while I was in the service overseas. The lessons I completed played a big part in helping me pass their screening examinations.
Vernon Skovgaard
Los Angeles 6, Calif.

FORMER NAVY MAN GETS JOB AT COLLINS RADIO

"Since my discharge from the Navy, I have been working for Collins Radio Company at Cedar Rapids, Iowa, one of the job opportunities you listed. I am giving a lot of credit to your course for helping me in passing the qualifications exam at Collins."
Howard Johnson, Marion, Iowa

TEAR OUT AND MAIL THIS CARD NOW!

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Sales Aids

RCA "COLOR FOUNTAIN"

An electronic fountain, used for the first time in a television commercial, has been used to introduce the new *RCA Victor* "New Orthophonic" high-fidelity line.

The fountain's color, height, and flow responds to the musical sounds from the high-fidelity instruments. The device was telecast in color on one of the recent *NBC*-TV spectaculars.

* * *

TUNG-SOL CARTOON BOOK

"The Finest TV Picture Ever Seen in The American Home" is the title of a sixteen-page, full-color cartoon book being released by *Tung-Sol Electric Inc.*, Newark 4, New Jersey as an aid to TV service technicians.

The booklet emphasizes the skill, integrity, and position of the television technician in the community. The story of the making and aluminizing the company's "Magic Mirror" picture tube is also told in language the customer can understand.

Dealers may get free copies of this good-will and sales-building self-mailer from *Tung-Sol* tube distributors or from the Sales Promotion Department of the company.

* * *

G-E TUBE DISPLAYS

General Electric Company's tube distributors are currently offering several window, wall, or counter display items promoting the company's line of electronic tubes.

Now available are an expandable window display background, a white plastic sign which is available either with an easel or wall hanger, and two giant tube cartons and two display flats in red-orange and blue. Additional flats can be obtained to accommodate any window size.

Contact your nearest *G-E* tube distributor for full details on these various promotion items.

* * *

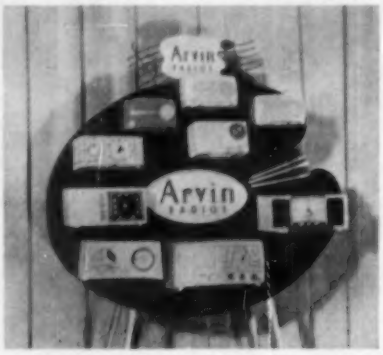
ARVIN SALES HELPS

Three new sales aids are being made available to dealers by *Arvin Industries, Inc.* of Columbus, Indiana.

Leading the list is a new "palette" permanent display which enables the dealer to show a large assortment of table model radios in any part of his store. Designed like an artist's palette, in green with red lettering on ivory the display has a pegboard background

panel. The display is six feet high and 40 inches wide.

The new "3D" illuminated sign is another item in the promotion package. It can be used for window, wall,



or counter and is adaptable as a night light for the dealer's store. It is 15" wide and 12" high.

The third item is a new display for the *Arvin* "Rainbow" line, a five-color promotion piece that can be used in any part of the store or as a window display. It measures 28" wide and 17½" high and is used in conjunction with radio samples.

* * *

NEEDLE DISPLAY CABINET

Jensen Industries, Inc., 7333 West Harrison, Forest Park, Illinois has developed a new combination needle storage and display cabinet which is designed to simplify the selling and restocking of phono needles for both jobbers and dealers.

The smart red-leatherette cabinet with gold lettering holds a maximum of 360 needles with each type of needle classified in drawer pockets. Each pocket holds up to five carded needles with full identification visible at an easily readable angle.

One needle can be removed without touching any other or without readjusting the index tab. In taking inventory it is only necessary to check the empty pockets to bring the stock up to maximum for each needle type.

* * *

RCA'S HI-FI CAMPAIGN

An extensive advertising and promotion campaign to introduce the new *RCA Victor* "New Orthophonic" high-fidelity line has been scheduled by the company's Advertising and Sales Promotion Department.

Consumer advertising of the line is already underway. In addition, the line will be featured in radio and television commercials. An itinerant display with color, motion, and flashing highlights with dealer promotional aids are being made available during the current quarter. Miniature adaptations of the display, with motion, are also available.

Dealers will also be able to obtain a new high-fidelity presentation book in full color, a new folder picturing all radios, phonographs, and tape recorders, and a new point-of-sale kit.

* * *

POINT-OF-SALE DISPLAYS

Two timely and eye-catching point-of-sale display pieces are now available to jobbers handling the *Oxford* line of replacement speakers.

One display, a window streamer, measures 17" across and 5½" in height. The other is designed to be hung over a line in the store and printed so that it can be read from either side.

For further information on how to obtain these streamers, write direct to

Oxford Electric Corporation, 3911 South Michigan Avenue, Chicago 15, Illinois.

* * *

CHRISTMAS ANTENNA PACKAGE

Snyder Mfg. Co. of Philadelphia, Pa. is packaging its modern-design "Rear-Deck Dual Auto Antenna" in a special Christmas package.

This gift wrap will be designed to encourage the purchase of these antennas as Christmas presents. The packages will be specially designed for department stores which have automotive departments and for chain stores.

The company is also planning special Christmas promotions for its television antenna lines.

* * *

"ACROSS AMERICA" CALENDAR

An attractive 1956 calendar containing twelve exclusive, full-color scenes from all sections of the country has been prepared by the Tube Division of *Radio Corporation of America*, for distribution by *RCA* distributors to their dealers.

The "Across America" calendar will carry dealer imprints and a choice of three sales slogans. In addition to the illustration and legible calendar pads, space is provided on each sheet for personal notes.

* * *

TOY TOOL KIT

Vaco Products Company, 317 E. Ontario Street, Chicago 11, Illinois is offering a miniature 6-piece personalized toy tool kit for the trade to give away to customers.

Available in quantities at low cost,

"Butta, I Donta Know Anybody In Australia. Cana We Go, Now?"

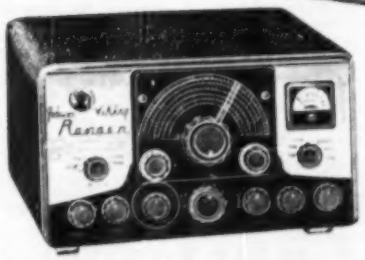
There is only one source you need to know when it comes to super trades on used (factory-built) test and communication equipment and that's Walter Ashe, the House of "Surprise" Trade-Ins. So for real money saving and satisfaction, get your trade-in deal working right now. Wire, write, phone or use the handy coupon below. Do it today!

ANNOUNCING
NATIONAL'S NEW DREAM RECEIVER— THE GREAT NC-300
Less speaker. Net $349.95

HALLICRAFTERS SX-100. Less speaker. Net $295.00

HALLICRAFTERS SX-99. Less speaker. Net $149.95

NATIONAL NC-98. Less speaker. Net $149.95



JOHNSON VIKING RANGER TRANSMITTER-EXCITER KIT. Net $214.50. Wired and tested. Net $293.00

WELLER MODEL 8100K SOLDERING KIT.

Includes soldering gun, wire soldering brush, soldering aid, and a supply of Kester solder. Packed in heavy cardboard case. Net $5.83

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FREE CATALOG!

WALTER ASHE RADIO COMPANY 8-10-55
1125 Pine Street, St. Louis 1, Missouri

☐ Rush "Surprise" Trade-In Offer on my _____

for _____
(show make and model number of new equipment desired)

☐ Rush New 1956 Catalog.

Name _____

Address _____

City _____ Zone _____ State _____

Send for your copy today

this toy tool kit consists of a miniature wrench, saw, square, hammer, pliers, and a midget screwdriver. These tools are all made of bright yellow plastic, except the screwdriver which has the company's regular "Amberyl" handle and blade of chrome-vanadium steel.

The firm's name is permanently imbedded in the screwdriver handle and

stamped in large white letters on the blue plastic tool holder, thus serving as a constant reminder to the customer.

Write the company for full details and prices on these tool kits in lots of one hundred.

• • •

GRILLE CLOTH DISPLAY

Wendell Plastic Fabrics Corp., 17 W. 17th Street, New York 11, N. Y. has two new "Mellotone" grille fabric merchandising displays available to jobbers.

A free display stand accommodates the special square-yard packages of the material while a special roll display is available for merchandising the fastest-moving patterns which the jobber can order in 20 to 25 yard rolls.

Twenty-two patterns are now available in the line. A sample book containing swatches of the materials is available from the company on request.

• • •

EICO DISPLAY BANNER

To help jobbers get maximum in-store sales power from the company's coordinated national advertising and publicity program, *Electronic Instrument Co., Inc.* of 84 Withers Street, Brooklyn 11, New York is making

available to all of its authorized distributors a new satin banner, as shown in the photo.

The white-and-black lettering, red satin background, and gold tassels are combined to produce an effective, eye-stopping display. —30—

What's New in Radio

(*Continued from page* 141)

tubular capacitor especially for use with printed circuits.

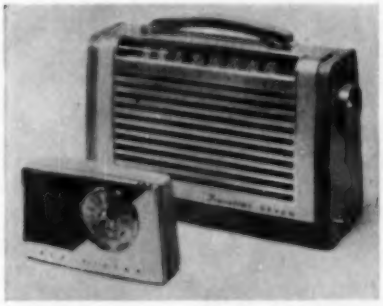
The new "Type BC" capacitors are encased in molded phenolic shells with two parallel lead wire terminals. These terminals are brought out from the end of the capacitor through a thermosetting plastic end fill compound and are spaced a fixed distance so that they can be plugged directly into printed circuits and dip soldered.

For other features, ratings, dimensions, and test data, write the company for a copy of its Engineering Bulletin No. 162.

RCA'S TRANSISTOR SETS

Radio Corporation of America is currently introducing two all-transistor portable receivers—one in a miniature size with six transistors and the other featuring a larger loudspeaker and case with seven transistors.

The Model 7BT9 six-transistor re-



ceiver comes in a plastic case measuring 5⅛" x 3¼" x 1⅛". The Model 7BT10 is approximately the size of the firm's present "Personal" portable which measures 10" x 6⁹⁄₁₀" x 3½". It is housed in a case of leather covered wood with aluminum trim and slide-rule dial.

Both radios feature circuits especially designed for use with transistors. Both receivers are said to have greater reliability and greater resistance to shock than conventional models.

G-E ELECTRON GUN

The Tube Department of *General Electric Company* has made available four new 21-inch and one 24-inch television picture tubes which require no external ion traps. This has been made possible by a newly-designed straight electron gun and a special aluminization control process developed by the company.

The new gun is being built into the 21BAP4, 21BCP4, 21BDP4, 21BNP4, and 24ZP4. Elimination of the external magnet requirement not only simplifies production but will simplify installation and servicing of the receiver in the home.

A feature of the new straight gun's design is the use of a newly-designed saddle strap "claw" which holds elements securely and requires fewer supports than normally used. Also contrib-

uting to the rugged construction is use of multiform glass beads of more uniform material than the glass normally used for this purpose. In addition, this new glass has less tendency to break down under high voltage.

SILICON POWER RECTIFIER

Bell Telephone Laboratories, 463 West Street, New York 14, N. Y. has announced the development of a tiny new electronic device which converts alternating current into direct current.

The new silicon power rectifier is

expected to have an almost unlimited life span and will be capable of operating continuously at temperatures up to 400 degrees F. Two of the rectifiers, when made about the size of peas, linked together and mounted on a cooling fin will furnish more than 20 amperes of direct current at 100 volts.

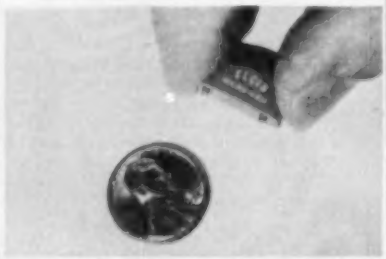
The company claims that since such minute quantities of the special silicon are required the cost of such silicon power rectifiers will be moderate. Production plans for the new unit are being worked out with *Western Electric Company*. Production will start soon for both the *Bell System* and for military applications.

"MICRO-CELL" BATTERY

The development of a button-size expendable battery which will not leak, swell, or gas has been announced by *Elgin National Watch Company's* Electronics Division, Elgin, Illinois.

The new "micro-cell" is especially adapted for hearing aid and transistorized circuit applications. The present cell, using indium as an anode, delivers about 1.15 volts compared with 1.35 volts for most other miniature cells. The company claims up to 2 years' service life for the new cell.

Although the developmental model is shaped as a half-circle unit, the



shape of half a dime and three times as thick, the battery may be produced in virtually any size or shape depending on the application.

"DO-IT-YOURSELF" KITS

The Gaertner Company of Los Angeles is manufacturing a new line of

educational "do-it-yourself" electronic kits which is being marketed under the tradename "Magna Electronic Kits." Budget priced, the new line includes a crystal radio, 1-tube battery or a.c. receiver, a 2-tube battery receiver, a 2-tube phono amplifier, a 3-tube phono and p.a. amplifier, a code oscillator, an amplifier, and a Geiger counter—each in kit form.

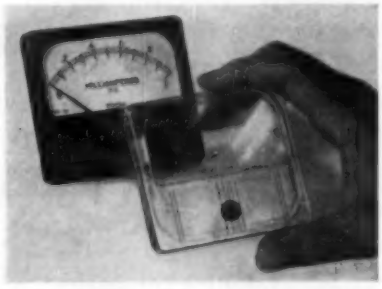
Each kit comes with a pre-punched, welded steel chassis with a baked enamel finish. All components are nationally-known brands and are guaranteed to be fresh stock. Some of the more complex components are factory assembled but all circuits are left for the builder to complete. Full, easy-to-read instructions and pictorial diagrams accompany each kit.

For a catalogue describing this kit line in detail, write to *A & M Company*, 616 So. Serrano Ave., Los Angeles 5, California, the distributor.

WESTON INSTRUMENT LINE

Weston Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J. is now offering its new Model 1331 line of flush rectangular instruments to the industry.

The new meters incorporate the company's self-shielded "Cormag" move-



ment which eliminates all inter-effects when instruments are mounted closely on the same panel and permits mounting on magnetic or non-magnetic panels without special adjustments.

The instruments have a one-piece snap-on front with zero corrector and the entire front surface, except for the window area, can be supplied in any color for quantity built-in requirements.

Case dimensions are 3.80" x 3.44". The line is available as d.c. and rectifier-type a.c. instruments in popular ranges. For complete literature including prices, write the company direct.

PRECISE SCOPE KIT

Precise Development Corporation, Oceanside, New York has announced the availability of its new low-priced, all-purpose economy 5" oscilloscope for general radio and television service applications.

Designated as the Model 315, the scope features frequency-compensated vertical and horizontal attenuators along with identical vertical and horizontal amplifiers. Both the horizontal and vertical sections are cathode-follower input type and are a.c.-coupled.

The vertical and horizontal ampli-

fiers are within ± 6 db through 500 kc. Basic sensitivity is approximately 250 millivolts per inch. Outputs are push-pull.

The new scope is available either as a kit or in factory-wired form. Write the manufacturer for full details on either the kit or the instrument.

TRANSISTOR RADIO

The Mitchell Manufacturing Company, 2525 North Clybourn Ave., Chicago, Illinois is currently offering a transistorized pocket radio which is only slightly larger than a package of king-size cigarettes.

The entire set measures 3" x 5" and is just a fraction over one inch thick. The receiver weighs 12 ounces. A shock-resistant case of genuine leather houses the radio. It is available in suntan, alligator, and antique white finishes. The set is powered by a single 22½ volt hearing-aid type battery and features a 2¾" permanent-magnet type speaker.

GEIGER COUNTER KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Illinois is now offering a low-cost Geiger counter kit under its "Knight" label.

The kit is supplied complete with pre-cut wire, solder, leather carrying handle, shoulder strap, headphone, batteries, radioactive sample, and AEC manual on uranium prospecting. Easy-to-follow pictorial diagrams and clearly written instructions insure easy and quick assembly.

For literature and full specifications on the No. 83-S-242 Geiger counter kit, write the company. —30—

Spot Radio News
(Continued from page 24)

Department of Justice look into their operations; in addition, the FCC was censured for their lack of control over network operations.

THREE RADICAL PLANS, involving channel shuffling, offered by Commissioners Lee and Doerfer and a Washington consultant, will also come under the scrutiny of all of the investigative bodies. Lee had suggested that the v.h.f. band be extended and any very-high FM, commercial, or government channels be swallowed up in the move and shuttled to higher channels. Doerfer turned the other way, and asked for the scrapping of the v.h.f. bands in the nation's largest cities, including New York, Chicago, and Los Angeles, with these stations placed on ultra-high channels. This move, he felt, would serve to develop the high bands and generate all-channel interest; the v.h.f. bands could be assigned to the smaller cities, it was said.

The consultant directed his plea to v.h.f. extension, claiming that at least 200 more channel 2 to 13 low-power assignments are still possible in over 100 large communities, through a liberalization of the present mileage-separation ruling. Separations could be altered, the plan said, through the use of directional antennas, power boosts or reductions, and antenna height adjustments. The directional antennas, it was noted, would serve to up signal strengths in the directions of populated areas, and provide a corresponding reduction of signal in the direction of those stations whose outputs might cause interference.

To illustrate the use of the plan, the consultant noted that a low-powered channel 2 to 6 station, operating with about 100 watts and an antenna at 500 feet, could be placed about 85 miles from an existing co-channel zone 1 (northeastern, middle Atlantic, and north central states) maximum power-maximum antenna height station, without causing any more interference than the existing station is liable to from a full-powered, co-channel telecaster 170 miles away, the present required mileage.

Many in Washington felt that the mileage-change plan was sound and offered one solution to the stalemate on the allocations board.

THE AIR-SPACE PROBLEM is not only of deep concern to telebroadcasters, but to those in aviation, too. For nearly a decade, the use of channels in the bands 108 to 132, 328.6 to 335.4 and 960 to 1215 megacycles has been subject to recurrent study.

In '46, the Radio Technical Commission for Aeronautics in Washington, developed a frequency-channel utilization plan which provided twenty channels within the 108 to 112-mc. band for ILS (instrument landing system) lo-

calizers and thirty channels within the 112 to 118-mc. band for v.h.f. omniranges or VOR. The channel spacing in this band was 200 kilocycles. Later in that year, a plan for the pairing of the localizer channels with glide-slope channels in the 328.6 to 335.4 mc. band was formulated; the channel spacing here was 600 kc. This program was predicated upon the following four concepts: (*1*) That VOR and DME (distance measuring equipment) would be installed on a 100-mile (statute) grid basis to provide area coverage. (*2*) That en-route navigation would be accomplished by the use of VOR/DME ground stations and airborne course-line computers. (*3*) That airways would be so laid out as to bypass airports and that ILS facilities would be installed at airports to provide navigational guidance for approach and landing. Where the amount of traffic would not justify a complete ILS, only the ILS localizer would be installed. (*4*) That, at the time the low-frequency and medium-frequency four-course ranges were decommissioned, a limited number of high-powered radio beacons would be installed to provide navigational guidance for high altitude, long-distance flights. These, in turn, would be decommissioned at the time the ultimate long-distance navigation-aid system, which will provide service over both land and water areas, is installed.

In the activation of the VOR system, the lack of DME and course-line computers required that the VOR units be installed on an *airway* rather than an *area* basis. Thus, the need for channels increased; this requirement was met by decreasing the channel spacing within the 108 to 118 mc. band from 200 to 100 kc., providing 39 ILS localizer and 60 VOR channels. A revised plan for pairing of the localizer and ILS glide-slope channels on a 2:1 basis was developed in '48. Later the plan was amended to provide a pairing for the 39 ILS localizer channels within 108 to 112 mc., 60 VOR channels within 112 to 118 mc., the 20 glide-slope channels within 328.6 to 335.4 mc., and 100 DME operating channels within the 960 to 1215 mc. bands. This latter plan, accepted internationally, provided a useful operating range of 30 miles for ILS/DME stations, and 100 miles for VOR/DME stations.

About five years ago, because of increased plane speeds and improved performance, it was decided to undertake the development of a plan which would afford a useful operating range of 200 miles for VOR/DME stations, to provide more satisfactory navigational guidance to aircraft operating at altitudes above 20,000 feet.

The frequency plan in effect at the time the development program was initiated, prescribed a minimum geographical spacing of 400 miles for VOR stations operating on the same channel. At lower flight altitudes, the service radius of a VOR is determined by line-of-sight characteristics of v.h.f. signals. At altitudes above 20,000 feet, however, a plane may be within line-

of-sight distance of two co-channel VOR stations. In this instance, the useful service radius of each VOR is determined by the relative strengths of the two VOR signals. In high-altitude, high-speed operations, the VOR station service radius governs the number of times the VOR receiver must be retuned en route to obtain usable navigational signals. In a study of a hypothetical transcontinental flight using v.h.f. omni-ranges, operating with a co-channel spacing of 400 miles, it was found that the plane's VOR receiver must be retuned fifteen times during the course of the flight. Assuming that the useful service radii of the VOR's could be increased to 200 miles, it would then be necessary to retune the VOR set ten times during the flight. It did not appear that the safety or expeditious conduct of the flight would be enhanced by the increased service radii of VOR's. Thus, it was decided that a high altitude VOR/DME system would, at best, be merely a convenience.

In a report, just released by RTCA, covering the conclusions established after a five-year study of the foregoing plan, it was revealed that high-altitude VOR (112-118 mc.) stations can be set up for co-channel operation with a minimum separation of 300 miles, while 100-kc. adjacent-channel operation is satisfactory for stations 150 miles apart, and 200 kc. is OK for adjacent-channel operation of stations 75 miles apart.

It was also disclosed that the 111 mc. channel has been found suitable for the transmission of VOR receiver calibration test signals on a secondary basis to the navigation aid service.

ULTRASONICS, acclaimed by a number of industries, has now found itself an enthusiastic audience among the medics. In Washington, the Veterans Administration has set up an intensive ultrasonic therapy program and placed it in operation in nine hospitals and one regional office.

To date, VA spokesmen say that ultrasonic treatments have helped to alleviate pain in many nerve and muscle

(*Continued on page* 164)

ailments. The VA hospital in Boston has reported a high degree of improvement among veterans treated, with ultrasonic apparatus, for bursitis, sciatica, stiff neck, muscle strain, arthritis of the spine, low back strain, and myositis, an inflammation of the muscles. In certain types of muscle cases, it has been reported, ultrasonic therapy has been found to relieve pain, spasm, stiffness, inflammation, and swelling.

VA officials emphasized that it does not consider ultrasonic therapy a cure-all; but the sound waves have shown a remarkable ability to penetrate areas heretofore beyond reach, stimulate nerve members that have resisted all other forms of therapy, and thus bring welcome relief to sufferers of a number of nerve illnesses.

The treatment involves the use of equipment employing a quartz crystal, oscillating between 800 and 1000 kc., in a small sound head. These sound waves are directed into the body through a coating of heavy mineral oil on the skin or underneath water, since air absorbs the waves.

The treatment was actually first introduced in Europe in 1928, but it found little favor in this country until many years later and then only among a few physicians. Recently, though, ultrasonics has made a deep impression among physical medicine doctors who have finally accepted this form of therapy as a permanent member of the nerve-aid kit.

A NOVEL PLAN that would bug-test toll TV over a period of three years has been submitted by a recently suspended u.h.f. station in the Allentown-Bethlehem-Easton, Pennsylvania area. The station, WFMZ-TV, has suggested that it operate a three-year pay-see TV service 56 per-cent of the time and normal u.h.f. programs for the remainder of the time, on a five-hour daily basis.

In offering the plan to the Commission, the station's operators said that they feel that this proving-ground test would reveal whether or not the idea of subscription TV has merit.

"There is presently no way of knowing whether subscription TV is in the public interest," the former u.h.f. broadcasters said. "If subscription TV solves the serious problem of educational TV . . ., if it can bring great cultural benefits on a much wider basis to more homes . . ., if it is a means of adding a new, dynamic and beneficial dimension to the economics of broadcasting, making greater possible use of more television channels, in more communities, then obviously the public interest will be served."

The Commission was also told that the station would not endorse any of the different forms of scramblers or decoders now available, permitting all, if such is practical, to participate in the experiment on some orderly, clearly-defined basis.

THE SNAIL-PACE TV-station authorization mood, which has prevailed in

Washington for too many months, continued to hang over the hearing rooms of the Commission.

It appeared as if interest in TV had just exited to the hills. But there was optimism about that the lull would not be with us much longer, and soon we should see a steady march of applicants and a stream of grants.

As we went to press, the Commission assigned new calls and OK's to operate to those stations detailed on page 22 of this issue.

TV, truly one of the miracle tools of the century, recently once again displayed its uncanny ability to peer into the unknown. In Washington, the U. S. Fish and Wildlife Service Department of the Interior, installed a closed-circuit TV system to observe and test experimental fishery methods and equipment under actual oceanic conditions. A TV camera, towed at depths of more than 60 feet, has provided striking scenes on a TV monitor that can be photographed for further study. Another demonstration of TV's versatility and fabulous potential . . . . . L.W.

HIGH VOLTAGE TROUBLE

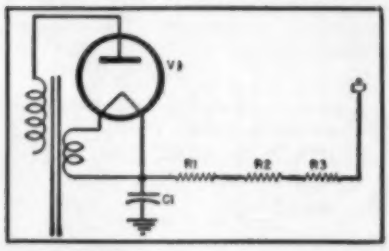
By DEE BRAMLETT, JR.

THE complaint on an Arvin television receiver model 6215CM was no raster; the sound was OK. This immediately suggested a high voltage defect or a defective picture tube.

The picture tube was checked and found to be good. Next, the voltage was checked at the high-voltage rectifier plate cap. A good arc was obtained using a screwdriver with an insulated handle. The voltage was then checked at the picture tube anode plug using a v.t.v.m., and only 3000 volts was found at this point. Normally this voltage would be approximately 12,000 volts. These tests localized the trouble to a defect in one of the parts shown in Fig. 1: the high voltage rectifier tube V_1, the high voltage filter capacitor C_2, or the three filter resistors R_1, R_2, and R_3. All of these components were carefully checked and found to be in perfect condition. However, one of them had to be at fault, so, new parts were substituted.

A new tube and high voltage filter capacitor were tried to no avail, but, when the three filter resistors were replaced, the high voltage immediately returned to normal. Apparently, when voltage was applied to these resistors, they increased in resistance and thereby decreased the high voltage. The solution to this trouble was simple, as it is with all "tough dogs" once they are discovered. —30—

Fig. 1. Partial schematic diagram of the high-voltage rectifier circuit of the Arvin model 6215CM TV receiver.



Width Troubles

(*Continued from page 57*)

course, when it feeds signal, through a secondary winding, to a keyed a.g.c. tube.

Increasing the supply voltage to the plate of the horizontal oscillator will sometimes boost width when the drive to the horizontal amplifier is insufficient and cannot be adequately boosted by suitable drive control adjustment. The method is most readily employed when the oscillator is fed from the normal "B+" supply; connect it to the "B+" boost voltage through a suitable resistor, in this case. The value of the resistor should be small enough to provide the required width increase. If the resistor value is too large, not enough width may be obtained; if it is too small, the horizontal amplifier will be overdriven, causing horizontal nonlinearity, generally in the form of vertical overdrive lines. A decoupling capacitor of about .1 μfd. may have to be added between the resistor terminal which feeds to the oscillator plate circuit(s), and ground.

Substitution of a new rectifier will often increase width, and should be tried before more involved procedures are attempted.

Excessive Width

When excessive picture width is present, but no other symptom is apparent, and suitable adjustment of the width control does not reduce the horizontal size to normal, the possibility of high line voltage should be investigated. If the line voltage is high at all times at the receiver location, one of the following procedures may be employed, to restore width to normal.

When a capacitor is present across the width coil, it may be changed to a unit with a considerably smaller capacitance, to boost the high voltage and thus decrease width. As an alternative, try increasing the horizontal amplifier's screen resistor substantially, or using a larger value of cathode resistance in this stage.

Circuit troubles that can cause excessive width include open width control and excessive drive (input) to the horizontal amplifier (possibly due to a loss of capacitance in the charge-discharge capacitor).

Height Troubles

The commonest source of trouble when height is insufficient is a loss of emission in a tube: most often the vertical amplifier, sometimes the vertical oscillator, low-voltage rectifier, or a horizontal circuit tube in cases where the "B+" boost voltage is applied to the vertical section.

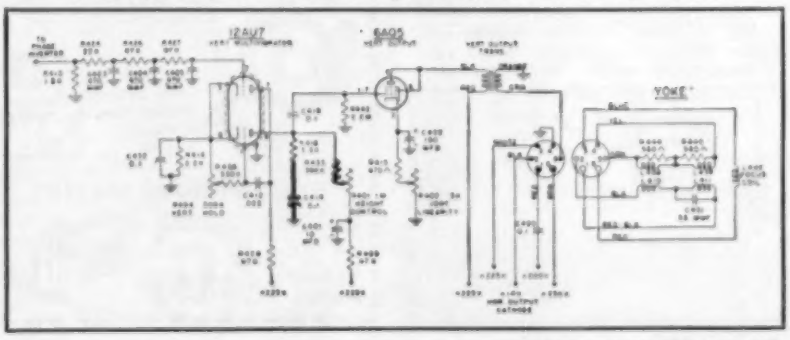
Leakage in the vertical charge-discharge capacitor (C_{28}, Fig. 3) will often manifest itself in a loss in height and a compression of the bottom half of the picture; loss in height and compression of the top half of the picture may be due to heater-cathode leakage in the vertical amplifier tube.

Other fairly common sources of trouble include: open or leaky coupling capacitor; open or shorted cathode bypass capacitor in the vertical amplifier; (excessive *or* inadequate height may be produced by a shorted capacitor); open or increase in the resistance of a vertical amplifier decoupling resistor; increase in value of the resistor in series with the height control (R_{29}, Fig. 3). A defective blocking oscillator or vertical output transformer may be the source of reduced height. So can a faulty vertical yoke (a trapezoidal raster will be produced in such a case).

It is often desired to obtain a relatively slight increase in height, with adequate linearity. When tube substitutions are unable to provide this, the height increase may be achieved in many cases by reducing the value of the resistor in series with the height control. A changed range of control results which (in some cases) permits better linearity at optimum height settings. A small reduction in the capacitance of the charge-discharge capacitor in the vertical oscillator circuit will also increase height, at the expense of a slight amount of nonlinearity.

When reductions in high voltage are made (as previously described), height as well as width will be increased. Definition as well as brilliance will, of course, be impaired if the reduction in high voltage is too great. Sometimes the voltage fed to the plate(s) of the vertical oscillator may be raised to

Fig. 3. Representative vertical sweep circuit, used in Westinghouse model H-223 TV receiver. The parts drawn in heavily are frequent causes of height troubles.



some extent, to increase the vertical sweep.

Excessive picture height that cannot be restored to normal by suitable height and linearity control adjustments may be caused by a decrease in the value of the resistor in series with the height control, reduction in the capacitance of the charge-discharge capacitor, shorted cathode bypass capacitor in the vertical amplifier or high line voltage combined with a slightly "hopped-up" yoke and power transformer (these components may both have outputs on the plus side of their tolerances). One make of yoke delivers as much as 2½-inches more height than others—a design variation that can cause trouble.

When no obvious circuit fault needs correction, height may be reduced by increasing the capacitance of the charge-discharge capacitor, or the high voltage may be increased by removing any capacitor present across the width coil, or using a smaller capacitance here. —30—

Carrier-Current Receiver

(*Continued from page* 53)

R_{11} until the first half of V_9 (S_2 still on) just cuts off. This will be evidenced by a sudden increase in background noise or the audio tone if the transmitter is still modulated by it. A reading taken from point F to ground should indicate a negative voltage between 1.8 and 2.5 volts, probably just under 2 volts. Since the voltage measured at this point will depend upon the proximity of the transmitter, as will the setting of R_2 when in service, R_{11} may have to be readjusted whenever the receiver is moved to a new location. This can be conveniently done through the perforations in the top cover with a long TV alignment tool. As mentioned previously, off-carrier noise suppression will be ineffective with fringe signal conditions. Since this type limiter does not affect noise under signal conditions in any case, nothing is lost with weak signals and S_2 in the "off" position. If S_2 were left on, the audio output would be considerably reduced, perhaps cut off entirely.

When it is known for sure that the receiver will always be operated at some distance (in excess of several city blocks at least) from the transmitter, a value of 10,000 ohms will be satisfactory for R_2, otherwise for close-up operation a value of 20,000 ohms would be better.

Assuming that all of the instructions have been adhered to closely, there should be no difficulty in operating this type receiver. —30—

Manufacturers' Literature

ASA SOUND STANDARD

The American Standards Association, 70 East 45th Street, New York 17, N. Y. has just published "American Standard Method for Specifying the Characteristics of Analyzers Used for the Analysis of Sounds and Vibrations," Z24.15-1955.

The standard has been prepared to help the user and manufacturer of analyzers not restricted to octave bands, as a much finer analysis is desirable for detecting some noises and reducing them at the starting point.

Different types of analyzers are defined in the document and characteristics are given for each. The standard deals with their frequency ranges, bandwidths, transient responses, input and output voltages and impedances, type of indications, power requirements, and extraneous influences.

The price of this new standard is 50 cents a copy. It is available direct from the Association.

MEASURING ATTENUATION

Shielding, Inc. of Riverside, New Jersey has issued details on a unique "do-it-yourself" procedure for measuring attenuation of shielding enclosures.

The method described provides attenuation measurements in the average plant laboratory over the frequency range of 100 kc. to 1000 mc. The method covered requires a minimum of equipment and will permit repeated measurements to be made in accordance with the latest military specifications for shielding enclosures.

Details on the test procedure and additional material on shielding enclosures will be supplied by the company on request.

NORELCO COUNTER

A new, 4-page folder that gives complete data on the *Norelco* PW 4010 "Pocket Battery Monitor" is now available without charge from the Research and Control Instruments Division, *North American Philips Company, Inc.*, 750 S. Fulton Ave., Mount Vernon, New York.

Technical information covers operation, sensitivity, tubes, and batteries. Details on accessories are also included. The instrument is used for radioactive surveying, tracer and contamination investigations, intensity checking, and exposure measurements in laboratories.

TRANSISTOR FLYER

Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y. has recently issued a four-page flyer covering transistors and components for use in transistorized equipment.

In addition to listing a wide selection of transistors, the flyer lists transistor transformers, miniature and subminiature components, kits for building transistorized code practice oscillators and radio receivers, books on transistors, etc. Schematic diagrams of several simple circuits using transistors are also included.

GERMANIUM POWER RECTIFIERS

International Rectifier Corporation, 1521 E. Grand Avenue, El Segundo, California has published a new bulletin which lists the ratings and specifications on its line of germanium power rectifiers.

Bulletin CPR-1 describes two styles of the line; the Style C natural convection cooled, and the Style F, fan cooled. Also included in this bulletin are the complete operating instructions and the typical dynamic characteristic curves for these two styles.

A copy of Bulletin GPR-1 is available on letterhead request to the company.

CONDENSED CATALOGUE

Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, New York has announced the availability of a new #6¾-envelope size condensed catalogue which describes the highlight features of the complete *Eico* kit and instrument line of 46 models.

Printed in red-and-black, the catalogue is laid out in a manner to facilitate addressing by the company's authorized distributors or to "ride free" as an envelope stuffer.

Although not intended to replace the firm's regular catalogue, the new mailing piece does help reduce jobbers' mailing costs in reminding their customers about the line.

For full details on how these condensed catalogues may be obtained, write the company direct.

TRANSISTOR APPLICATIONS

The construction of a frequency meter using transistors instead of vacuum tubes is described in an Army Signal Corps research report just released to the industry through the Office of Technical Services, U.S. Department of Commerce.

The results of the preliminary research, details of design and construction of the frequency meter, and the conclusions reached as to transistor application are given in the report, PB 111610 "Application of Transistors to Electronic Counting Equipment." The report, containing 77 pages with circuit diagrams, drawings, and photographs, may be obtained from OTS for $2.00 a copy, Washington 25, D. C. Payment must accompany all orders.

DEUTSCH CONNECTORS

A new data sheet describing its line of electrical "quick-disconnect" connectors has been issued by *The Deutsch Company*, 7000 Avalon Blvd., Los Angeles, California.

(*Continued on page* 170)

Of interest to the electronic, instrument, radio, television, and allied industries, the new connectors are designed to be used where equipment requires frequent removal, repair, or replacement; installation in cramped or inaccessible quarters; fast action; or where the equipment has to be connected and disconnected frequently.

The bulletin also contains information on how the "quick-disconnect" feature works and a description of the insulation material, pin, and socket contacts. Specifications include a brief description of various shells and dimensions on throughwall mounting and box mounting receptacles, straight and 90 degree elbow plugs.

A copy of Bulletin PD-1 is available on request.

APPLICATIONS OF SOUND

The Engineering Products Division, Building 15-1, *Radio Corporation of America*, Camden, New Jersey has issued an attractive 12-page booklet which describes the key functions of industrial sound systems.

Applications of sound and typical equipment are briefly discussed and amply illustrated. Written in easy-to-read, non-technical language, this booklet explains how sound can be used to simplify plant administration, coordinate production, improve employee morale, provide effective voice control of all plant functions, and save valuable manpower.

When writing for a copy of this booklet, please specify Form 3R2478.

TAPE RECORDER USES

Magnecord, Inc., 1101 South Kilbourn Ave., Chicago 24, Illinois has published an attractive new booklet which outlines briefly 207 valuable uses for a tape recorder in the home, in business, in education, etc.

The booklet also illustrates how simple it is to record and play back in addition to giving hints on splicing tape, preserving tape, and using a tape recorder for best results.

This new booklet is available from the Advertising Department of the company for 25 cents a copy.

NEW GEE-LAR CATALOGUE

Gee-Lar Manufacturing Company, 819 Elm Street, Chicago, Illinois now has available copies of its fully-illustrated 16-page brochure which will be distributed without charge to the radio-television industry.

Detailed descriptions are provided on the firm's line of TV and radio products, including all kinds of knobs for replacement, experiment and original equipment use; switches, and other service items.

CONTROL COMPONENTS

A new four-page catalogue describing a complete line of control components for industrial use is now being offered by *Automatic Electric Sales Corporation*, 1033 West Van Buren Street, Chicago 7, Illinois.

Equipment listed includes stepping

switches, relays, and key switches. Descriptive matter covers the functions, specifications, and an illustration of each relay and switch.

A copy of Circular 1843 will be forwarded without charge on request.

KLEIN PLIERS DATA

Mathias Klein & Sons, 7200 McCormick Road, Chicago 45, Illinois is now offering a compact folder which illustrates and describes the most popular pliers in its line.

The folder is indexed to facilitate use. Copies are available without charge to those requesting Bulletin No. 455.

MICROWAVE RELAY SYSTEMS

A new 226-page service manual on wave propagation and other aspects of v.h.f. and microwave radio relay systems has been prepared by the Government Service Department of *RCA Service Company, Inc.*

The publication, titled "Point-to-Point Radio Relay Systems—44 mc. to 13000 mc." was originally published under contract for the Air Force which has approved the reprinting and commercial sale of the volume.

The textbook was designed for use by electronic engineers, technicians, and students and is available from the Government Service Department of *RCA Service Company, Inc.*, Camden, N. J. at $2.00 each postpaid. In quantities of ten of more, copies are $1.80 each postpaid.

DATA FOR URANIUM HUNTERS

Valuable data for uranium prospectors is included in a 20-page, pocket-sized booklet being offered by *Precision Radiation Instruments, Inc.*, 4223 W. Jefferson Blvd., Los Angeles 16, California.

Entitled "64 Questions and Answers on Geiger Counters and Scintillators," the booklet covers in layman's terms such subjects as claim staking, government bonuses, assaying of radioactive ores, aerial and ground surveys for uranium, oil and gas fields, effect of weather on radiation, uses of various types of instruments, and other interesting information.

Copies of this booklet are free upon written request to the company.

HI-FI DIRECTORY

Audio Fair Publishers, 67 W. 44th Street, New York 36, N. Y. will issue a descriptive directory and buyer's guide, "Audio Fair—Hi-Fi, Why, What & Where to Buy" which will make its initial appearance at the New York Audio Fair early in October.

Advance copies will be sold to visitors for fifty cents a copy. Following the Fair, it will receive further distribution through newsstand sales in all parts of the country as well as in hi-fi dealers' sound studios, where it will sell for $1.00 a copy.

The directory will be sectionalized with various portions devoted to editorial material, listings of manufacturers, listings of dealers, and a di-

rectory of exhibitors at the New York Audio Fair.

Among the editorial contributors to the directory will be Oliver Read, Editor and Assistant Publisher of RADIO & TELEVISION NEWS, John Briggs, music critic of *The New York Times*, Charles Fowler, editor of *High-Fidelity*, and C. G. McProud, editor of *Audio Magazine*.

G-E TUBE CHART

The Tube Department of *General Electric Company* has issued a selection chart which lists 40 of the company's 600 ma. series-string receiving type tubes, all of controlled heater warm-up design, which is available from any of the firm's three regional offices of the equipment sales organization of the department.

The chart classifies the tubes according to elements; lists typical service, heater voltages, maximum plate and screen dissipation ratings; and gives average characteristics.

The chart may be obtained from the *G-E* Tube Department offices at 200 Main Avenue, Clifton, N. J.; 3800 North Milwaukee Ave., Chicago 41, Ill.; or 11840 West Olympic Blvd., Los Angeles 64, California. Ask for chart ETD-1163.

NEW CTC CATALOGUE

Cambridge Thermionic Corporation, 445 Concord Avenue, Cambridge 38, Mass. has just released a comprehensive new catalogue which has been designated as Catalogue No. 500.

The publication includes complete specifications, actual size illustrations, and schematic diagrams of all of the company's standard electronic and electrical components. Solder terminals and swagers, terminal boards, hardware, insulated terminals, coil forms and wound coils, and capacitors are each given a complete section and full details for ordering the many types of each unit are included.

The catalogue is three-hole punched for easy reference and filing and is available upon written request to the company.

SUPREME "MASTER INDEX"

Supreme Publications, 1760 Balsam Road, Highland Park, Illinois is offering readers of this magazine a copy of its latest "1955 Master Index" covering all of the firm's radio and television manuals.

Although the index is normally priced at 25 cents a copy, RADIO & TELEVISION NEWS readers may obtain a copy by sending a 5 cent stamp, to cover postage, to the publisher.

MUELLER CATALOGUE

Mueller Electric Company, 1583H East 31st Street, Cleveland 14, Ohio has recently issued a new and revised catalogue covering its complete line of electrical and electronic clips and insulators.

The 18-page illustrated publication covers all late revisions, including the company's many new miniaturized and

special insulated clips. Catalogue No. 180 is available free from the company on request.

WESTON INSTRUMENTS

Weston Electrical Instrument Corporation, Newark 5, N. J. is offering a copy of its new Catalogue A38B which fully illustrates and describes the firm's complete line of ruggedized and sealed panel instruments in 1½", 2½", 3½", and 4½" sizes; a.c., d.c., r.f., and thermo, in both commercial and military types.

Instruments in the 2½", 3½", and 4½" sizes have an external zero corrector and all instruments may be readily opened and resealed using only an ordinary screwdriver. The booklet includes information on design and construction features and on the test procedures employed by the company to insure dependable accuracy in service under extremes of shock, vibration, temperature, humidity, or general abuse.

The new catalogue is available without charge on request. Please specify Catalogue A38B when writing the company. —30—

Standard Coil Tuner

(*Continued from page 58*)

spring mounted on the front of the coil support assembly is broken. As a result, the coil strips are no longer held in place properly. To repair this, the entire coil support assembly can be replaced.

The most annoying difficulty is the loss of the oscillator tuning slug "G," particularly when its retaining spring, "Q" in Fig. 2, is also missing or broken. A generous supply of these items is included in the repair kit and many otherwise tedious and annoying repair jobs can be solved simply by the availability of these relatively inexpensive parts.

One frequent defect found in older turret tuners is a broken contact spring or cracked contact block. In Fig. 2 the part marked "I" is the entire contact block assembly which includes the kidney-shaped contact springs all mounted in position. To replace this part, remove the two screws at the front and rear of the chassis which hold the assembly against the chassis. Then unsolder the edges and mating tabs which hold the side shield "P" in place and snap the shield plate out. Next, unsolder the locating tabs at the bottom of the contact block assembly "I" and gently slide this assembly upward and away from the main chassis.

The new contact block assembly is first located in the two tabs, then held firmly by the two front and rear screws and finally, the edges are soldered to the main chassis. Be sure to replace the side shield plate as well as the bottom cover if the particular tuner uses one.

In repairing the fine-tuning assembly it is important to first remove the screw holding the fine-tuner ground plate "K" to the chassis. After this part is removed, the outer shaft "C" together with the fine-tuning rotor blade can be slid forward and slipped off the main shaft. Always be sure to replace the forked spring "M" and the fiber washer behind it when reassembling the fine-tuning portion. By the way, the ceramic disc which lies under the fine tuning rotor, item "L" in Fig. 2, is also replaceable and is included in the kit of parts shown in Fig. 3.

Not shown in Fig. 2 are the various i.f. coils and traps which are used on the different models, but they are included in the repair kit as well as the various critical r.f. chokes and neutralizing coils which make up the v.h.f. tuner circuit.

Such important mechanical parts as the drum retainer springs, "H" in Fig. 2, are also supplied and anyone who has ever tried to find one of those springs after incautiously letting it jump away, will appreciate this. A word of advice on removing these springs may help avoid cut faces, fingers, or other minor injuries. When prying the free end of the spring loose with a screwdriver, hold one finger firmly over the hooked end of the spring, pressing it against the chassis. It is also good practice to remove the screw holding the detent spring in place before trying to remove the drum assembly.

Standard Coil tuners are identified as types "F," "H," "K," "Q," or "Q/R," with different serial numbers assigned to each letter. For replacement parts purposes, the letter is sufficient for identification.

As concerns the replacement of any of the electrical parts, it should be mentioned that whenever feasible, exact replacements should be used. Keeping location and lead length of individual coils or ceramic capacitors the same as originally found on the tuner will avoid any chance of regeneration and eliminate the need for realignment of the entire tuner in many instances.

Together with the replacement parts kit, data on the i.f. frequencies and other characteristics of the various tuner models is available. All this permits the service technician to do a large number of tuner repair jobs which previously would have meant either a complete new tuner or a long waiting period until the correct part was obtained from the set manufacturer. —30—

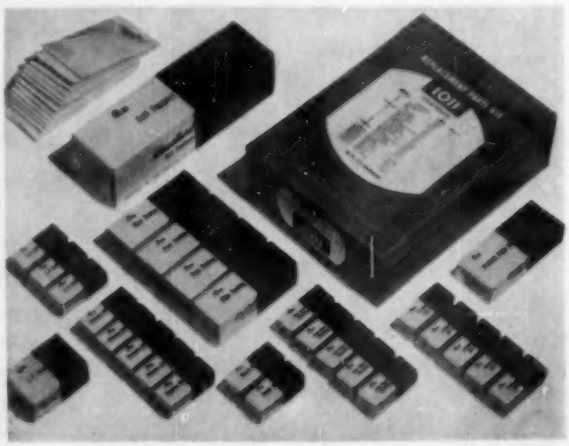


Fig. 3. Standard Coil tuner parts replacement kit available at electronic parts distributors for the repair of defective tuners. All of the various parts shown are in large package.

TELEPHONE EQUIPMENT

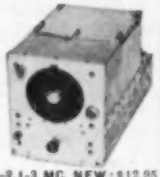
RM-12 REMOTE CONTROL TELEPHONE OR RADIO—
Equipment Contains EE-8 Field Telephone Ringing System, Handset, DB Meter, and Switching System for monitoring or remote control of Radio Sets.
NEW: $24.95 USED: $19.95

EE-8 FIELD TELEPHONE—
Ideal for private telephone system up to 15 miles for two or more phones. Has internal ringer & Handset. Requires 2 flashlight Batt. W/carrying case & shoulder strap. USED, Checked..... **$14.95**

BD-72 SWITCHBOARD—12 Line Portable, Local Batt., Monocord Magneto Type w/Night Alarm Bell, Can be used with EE-8. USED: **$39.95**

WIRE: Weatherproof Wire, Twisted Pair:
500 Ft.—$4.75 135 Ft.—$1.50
Copperweld Weatherproof, 2 Wire.....1200 Ft. $10.00
Combat Wire W-130.....Per Ft. .01¢

BROADCAST RECEIVER



NAVY TYPE—520—1500 KC NEW: $24.95—Used: $14.95
NAVY TYPE Receiver—6-9 MC. Less Tubes. Used: $3.00
BC-455 REC.—6-9 MC. W/ Tubes .....Used: $4.95
R-28/ARC-5 REC. —100-156 MC. W/Tubes Used: $10.95
NAVY TYPE COMM. TRANS.—2.1-3 MC. NEW: $12.95 USED: 8.95
NAVY TYPE COMM. TRANS.—3-4 MC. USED: 12.95
BC-458 TRANSMITTER—5.3-7 MC.....NEW: 5.95 USED: 3.95
BC-459 Navy Type TRANS.—7-9 MC.....NEW: 7.95 USED: 5.95

TRANSFORMERS—115 V. 60 CYCLE PRI.:

600 VCT/100 MA—6.3 V/5 A; 5 V/3 A.....$4.95
650 VCT/50 MA—6.3 V/2.5 A; 6.3 V/.6 (Rect. 6x3) 1.95
350 VCT/40 MA—6.3 V/2.4 A; 6.3 V/.6 (Rect. 6x3) 1.75
2500 V/.015 A; 2.5 V/17A A; 6.3 V/.6A..... 8.95
1850 V/12.6 MA Tapped 2.5 V. 2 A..... 5.95
1100 V/80 MA.; 7.5 VCT/3.25 A..... 5.95
9 Volt CT—3A Amb. Tapped 4.5 V..... 7.95
12 Volt—Two separate windings—4 Amp each.... 5.95
28 Volt 8 Amp Tapped 4 Volt..... 5.95
5 V/2 A; 5 V/2 A; 5 V/2 A; & 5 V/6 A..... 2.95
600-0-600 VAC—200 MA. (2.5 V. 2 A.; 12.5 V. @ 2 A.; 5 V. @ 3 A.—#H-100—Price. 8.95
250-0-250 VAC—50 MA. 24 V. 1 A.; and 6.3 V. 1 A. #H-100—Price..... 4.95

CURRENT TRANSFORMER—Ratio 150 to 5; 25 to 60 cycle. West Style 81869..... $8.95
CONSTANT VOLTAGE REGULATOR—115 Volt 60 cycle, 80 VA. Sola #30720..... $12.95

Choke 12.5 Hy/100 MA..... $1.95
Choke 15 Hy/165 MA., 125 Ohm..... 1.95
Choke 5 Hy/150 MA., 85 Ohm..... 1.50

BC-221 FREQUENCY CASE

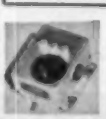
BC-221 FREQ. CASE—Aluminum Case for BC-221 or TS-164 Freq. METER—W/ Voltage Regulator Supply using 1/VR-105—2 Ballast Tubes. Relay, Cable, etc. Front Comp. 9⅝" x 7½" x 7⅝". Rear Compartment 2" Deep. Shock-Mounted..NEW: **$3.95**

DYNAMOTORS:

HEAVY DUTY MOBILE DYNAMOTOR:
DM-42—14 V. input; output 1030 VDC—200 MA. & 515 V. 215 MA. @ 6 VDC. Approx. half of Voltage.....NEW: $12.95—USED: $8.95

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW
14 VDC	330	150	BD-87	$3.95	$5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	20.95
14	500	500	BD-500		12.95
14	600	300	BD-86		12.95
28	1000	350	PE-73	8.95	
12 or 24	275	110	USA/0515		4.95
12	230	90	PE-133	4.95	6.95
14 VDC	375	150	BD-83	3.95	4.95
12 VDC	220	80	DM-34	2.50	4.95

ALL ITEMS PREVIOUSLY ADVERTISED STILL AVAILABLE—SEND FOR LIST!



ANTENNA RELAY UNIT—

BC-442 consists of switching relay, 0-10 RF indicator, & 50 MMF Vacuum Capacitor...NEW: **$3.95**

REMOTE CONTROL UNITS:

RM-21 For BC-669 Radio Set.....NEW! $4.95
TRANSMITTER CONTROL BOX AVT-15—With Batt. Cable (10'), Control Cable (5'), Plugs, Fused Terminal Box, Control Box (5" x 4" x 3"). Has Charge and Discharge 0-20 Ammeter, On & Off Sw. for Generator & Trans. Also Mic. & Phone Jacks and Dash Mtg. .....NEW: **$7.95**
CD-515 Cable F/BC-669 Set to Pwr. Supply.....$2.75
BC-375-191 Cables PL-59-61 or 64 ea. end. Each: 2.75
TCS Cables—Rec. to P.S. or Trans. to P.S. Ea.: 2.75

METERS:

WESTON AC AMMETER:
(Pictured) In portable leather case, with Test Leads, 2½", 0-15 AC and 0-3 AC Scale..... **$5.95**
DC AMMETER HOYT: In portable metal case with Test Leads, 4½", Fan, Mirrored Scale 0-15 ADC.....$4.95
0-3 RF AMMETER IB-128: 2½" Rd.....NEW: 2.95
0-8 Amp RF w/Thermocouple IB-89: 2½" Rd... 4.95
0-15 AC-DC—2½" Rd.; IB-122..... 4.95
0-500 MA DC—2½" Rd.; IB-22..... 4.95
0-1 MA DC Simpson; 3½" Rd..... 3.95
0-2 MA DC Westinghouse; 3½" Rd..... 2.95
0-20 MA DC Westinghouse; 3½" Rd..... 2.95
0-150 V. 60 cycle; Simpson; 3½" Rd..... 3.95
0-250 MA DC—DeJur, 3" Sq..... 3.95
AUDIO OUTPUT METER—Portable. Five Ranges 0/1.5, 15, 60, 150 Volts AC. Res.—4000 Ohms. Plastic Case P/D 1-50 Test. NEW: $5.95—USED: $4.95

RECEIVER—TRANSMITTER

BC-229/429—RECEIVER TRF—With 3 Plug in Coils for Freq. 201 to 398; 2500-7700 KC; Six Tubes: 1/37—1/38—3/39. Size: 16" x 8" x 7". With Schematic. Price. USED: **$6.95**
BC-230 TRANSMITTER—Voice modulated, with 5 Plug in Coils for Freq. 2500 to 7700 KC. Four Tubes: 2/19y—2/45 & 0-1.5 RF Meter. Size: 13" x 8" x 7". With Schematic. Price.....USED: **$8.95**
PLUGS to fit BC-229 or BC-230.....Each: 75¢
CONTROL BOX F/BC-229 or BC-230..Ea.: 75¢
TUNING KNOBS F/BC-229 or BC-429..Ea.: 65¢
COILS F/Rec. 201-398; 2500-4150; 4150-7700. Each: $1.75
COILS F/Trans.—2500-3200; 3200-4000; 4000-5000; 5000-6210; 6210-7700 KC. Ea. Coil: $1.50
SET of 5 Coils..... $5.00

ANTENNA EQUIPMENT

MAST BASES—INSULATED:
MP-22 BASE — (Illustrated) Ins. spring action; direction of bracket can be raised or lowered easily..... **$2.95**
MP-S-33 BASE—Insulated type with heavy coil spring and 5" dia. Ins. Requires 2" hole for mounting. Weight: 9 lbs..... **$5.95**
MP-48 BASE—Insulated type base with heavy coil spring. Requires 1⅝" mounting hole. Weight: 11 lbs..... **$4.95**
MP-37 BASE—Insulated type with heavy coil spring. 7" dia. Insulator; requires 1⅝" hole for mounting. Weight: approx. 10 lbs..... **$6.95**

MAST SECTIONS FOR ABOVE BASES:
Tubular steel, copper coated, painted in 3 Ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section.....@ 50¢ Each
Larger Diameter Section: MS-54.....75¢

COAXIAL CABLE & CONNECTORS

COAXIAL CABLE: Price Per Ft. 100 500 1000
RG-8/U 51.5 Ohm (Special)..... .07 .06½ .06
RG-34 71 Ohms—145 Ft. Length.....$15.00 Per Lgth.
RE Tractable Cord—3 Cond. #22, 10' $1 Ea. 12 f/$10
CD-1071 CORD—With PL-259 Plugs each end, 50 ohm coax 2 Ft. long. Prices: 50¢ Each—Or in Lots of 10 @ 50¢ Ea.
PL-259—Plug, Ea. End & 32"—RG-54/U—58 ohm .50¢
BC-239 Chassis Conn. 1/PL-259 (Removed)..3 for $1.00
UG-21/U—Plug ea. end & 32"—RG-11/U—75 ohm .50¢
UG-22/U—With 4" Coaxial Cable.....50¢

FM RECEIVER
27 to 38.9 MC

Four Preselected Channels—Frequency Ranges 27 to 29.5—29 to 32—31.5 to 34.4—and 34.4 to 38.9 MC. Complete with 16 Tubes: 1/12BA7; 3/12BC7; 2/12BG7; 2/12BJ7; 1/VR-150; 1/6H6; 1/6BJ7; 2/6SL7; 1/6V6; 2/6AC7; 1/NE-20 and DC-14 Crystal 1000 KC.; Crystal Calibrator, and Speaker. Power required: 12 or 24 V. DC and 275 V. DC 150 MA. Size: 6⅝" x 11½" x 11½". BC-923 RECEIVER.....NEW: **$34.95**
12 Volt DYNAMOTOR for BC-923..... $5.95
AC POWER SUPPLY, 115 V 60 cycle, 1/BC-923 $3.50
PLUG for Rear of BC-923..... 1.00

RANGE BEAM FILTER

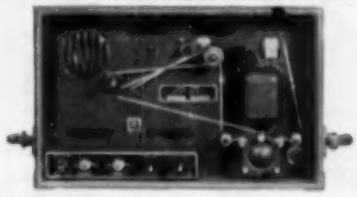
NAVY TYPE—Similar to FL-8 & FL-30, 1020 cycle Acceptance or Rejection w/PL-55 Cord & Plug for plugging into output of Rec. Also Two output Phone Jacks. A fine piece of equipment.....NEW: **$1.95**
FL-8 Filter, Used: $1.49—FL-5 Filter: $1.00.

BLANK PAPER TAPES FOR CODE RECORDERS

¾" Wide, in 500 Foot Rolls—Prices: 25¢ Each—or 6 Rolls 1/$1.00—20 Rolls 1/$3.00—60 Rolls 1/$5.00

PRACTICE CODE TAPES & TG-34A KEYER

PRACTICE CODE TAPES—Code Training and Practice Inked Paper Tapes on 16MM 400 Ft. Reels for Telegraph and Radio Operators. Fifteen (15) Reels to a Set—in Wood Case. For use with TG-34A or TG-10 KEYERS.
COMPLETE SET—Price: **$14.95**



TG-34A KEYER—115 or 230 Volts at 50 to 60 cycles—an automatic unit for reproducing audible code practice signals previously recorded in ink on paper tapes. By use of the self contained speaker, the unit will provide code practice signals to one or more persons—or provide a keying oscillator for use with a hand key. Unit is compact in portable carrying case, and complete with Tubes, Photo Cell and Operating Manual. Size: 10⅝"/₁₆" x 10½" x 15¹⁵/₁₆". Shipping weight: 40 lbs.....NEW: **$16.95**

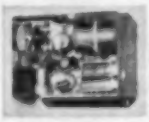
SET OF 15 TAPES and TG-34A KEYER—BOTH: $30.00

TG-10 KEYER— Same function as TG-34A—only larger—using 2/6N7—2/6L6—2/6BJ7—1/5U4G Tubes and 1/923 Photo Cell. Housed in standard Metal Cabinet, can be removed for 19" rack mtg. Size: 11" H x 24" W x 10½" D. Price—USED, TESTED.....Only **$17.95**

SOUND POWERED HEAD AND CHEST SET

Navy Type—No Batteries Required—Ideal for TV Antenna Installations and many other uses. 30 Ft. Cord. Used—Tested:..... **$3.95** EA.

NOVICE BAND TRANSMITTER



TRANSMITTER AND AUTOMATIC KEYER
T-121—3.5 to 4 MC; 50 Watt Crystal Control (Crystal in Novice Band) MO. P.A. for CW. W/2/1625, 1/25L6 Tubes & Crystal Keyer consists of 24 VDC Keyer Ass'y & Code Wheels. Size: 8½" x 6¾" x 9½". W/In-struction Book. NEW: **$7.95**

BC-375 TRANSMITTER And TUNING UNITS

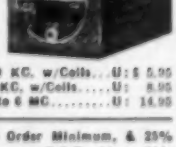
BC-375 100 Watt TRANSMITTER—Voice CW—Freq. 200-500 KC., 1500-12500 KC. by use of plug in Tuning Units. Uses 1/10y & 4/VT-4C Tubes. Sizes: 23" L. x 21" H. x 8" W. Complete with Tubes, less Tuning Units—Price.....USED: **$29.95**

TUNING UNITS For BC-375 & BC-191:

	NEW:	USED:
TU-5—1.5 MC to 3MC	$5.95	$4.95
TU-6—3 to 4.5 MC	....	2.95
TU-7—4.5 to 6.2 MC	3.95	2.95
TU-8—6.2 to 7.7 MC	3.95	2.95
BC-306 Antenna Tuner	3.95	2.95

CABLES PL-64-61 or PL-59 Each End.....Each: 2.75

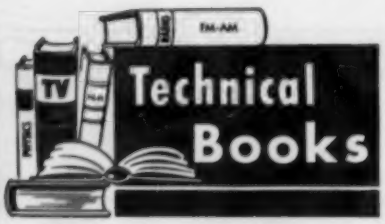
BEACON RECEIVER



BC-1206 CM—306-400 KC., Setchell Carlson, operates from 24-28 VDC, 5 Tubes, 135 KC IF—Size: 4" x 4" x 6". NEW: **$9.95**
BC-229/429 REC., 2500-7700 KC. w/Coils...U: $ 5.95
BC-230 TRANS., 2500-7700 KC. w/Coils.....U: 8.95
BC-748 TRANSCEIVER—3 to 6 MC.....U: 14.95

Address Dept. RN • $5.00 Order Minimum, & 25% Deposit on C.O.D.'s. • Prices are F.O.B., Lima, Ohio

FAIR RADIO SALES 132 SOUTH MAIN ST. LIMA, OHIO



"HANDBOOK OF 630-TYPE TV RECEIVERS" by Simon S. Miller & Howard Bierman. Published by *John F. Rider Publisher, Inc.*, New York. 191 pages. Price $3.50. Paper bound.

Since many of the original *RCA* 630 chassis are still in the hands of the public and many variations of this circuitry have been incorporated in present-day television receivers, it behooves the service technician to have a thorough understanding of all of the components that comprise this popular design.

The authors of this handbook have done an admirable job of it. The subject has been covered carefully and in minute detail. Separate chapters are devoted to tuners, video i.f. amplifier and detector, the sound section, sound and picture i.f. alignment, a.g.c. systems, video amplifier and d.c. restorer, sync circuits, horizontal deflection and high voltage section, vertical circuit, low voltage power supply, and the picture tube. An extensive troubleshooting chart is an especially welcome addition as are the three complete schematic diagrams of the original *RCA* 630, the *Tech-Master* Model 1930 S-9, and the *Video Products* Model 630-K3C which are inserted in the back of the book and are removable, if desired.

Details on converting the older circuits to accommodate picture tubes as large as 27 inches, have also been included by the authors.

Any technician who works on 630-type chassis—which should include practically every "pro" in the business—will want a copy of this handbook for his service library.

* * *

"THE A.R.R.L. ANTENNA BOOK" by the ARRL Staff. Published by the *American Radio Relay League*. 306 pages plus catalogue section. Price $2.00. Paper bound.

The radio amateur—no matter what his interest—will find this book an invaluable aid in the selection and construction of the correct antenna for his particular type of operation.

On the logical assumption that "why" is as important as "how," the early chapters of the book are given over to antenna theory. There are chapters on wave propagation, antenna fundamentals, and the transmission lines to be used with various types of antenna installations.

The balance of the book covers specific antennas including multi-element directive arrays; long-wire antennas; multiband units; antennas for 160 meters; for 3.5 and 7 mc.; for 14, 21, and 28 mc.; v.h.f.-u.h.f. antennas; construction of suitable supports; rotary beam

construction; determining directions; the construction of receiving antennas; and details on various types of mobile antennas.

A bibliography covering additional sources of data is also included. The catalogue section provides a valuable list of sources for amateur equipment of all types.

* * *

"RCA TV TROUBLE INDICATING TUBE LOCATION GUIDES" by H. G. Cisin. Published by *Harry G. Cisin*, Amagansett, N. Y. Pages unnumbered. Price $1.00. Paper bound.

This is a fairly complete listing of the tube locations for *RCA* receivers produced from 1947 through 1955. The various models are identified by name and chassis number in the index and the appropriate tube guide for the set is indicated. Each guide shows positions of all tubes and indicates the effect of each tube on the operation of the set. By means of code letters the function of each tube is clearly indicated.

In addition to supplying data on both black-and-white and color receivers in the *RCA* line, this compact handbook contains a tube substitution table covering the tubes most commonly used in television receivers. Only tubes which can be substituted without circuit changes appear in this listing. A second table lists tubes by circuit function to aid in identifying unfamiliar circuitry.

The entire manual is small enough to be carried in the technician's tube caddy for ready reference on home service calls.

* * *

"DICTIONARY OF TELEVISION, RADAR AND ANTENNAS" compiled by W. E. Clason. Published by *Elsevier Press, Inc.*, 2330 Holcombe Blvd., Houston 25, Texas. 760 pages. Price $21.50.

This monumental work is presented in six languages, English, French, Spanish, Italian, Dutch, and German which should give the user the key to most of the technical electronic literature being published today.

The fact that new or parallel experiments are going on in the field of electronics in various sections of the globe makes it more necessary than ever for the engineer and research man to keep abreast of these developments. In order to do this, many company libraries and engineering school reference rooms subscribe to a number of foreign publications for the benefit of their personnel and students.

Because of this trend, it is imperative that a technical dictionary such as this be available in order to provide accurate interpretation of the material contained in foreign language publications. The author, a long-time aide at *N. V. Philips' Electrical Works* in Eindhoven, Holland has spent a lifetime in the field of technical documentation and associated subjects. From his vast experience he has prepared this dictionary on the basis of the need he knows exists for this type of work.

The material is presented alphabeti-

cally in English in this edition with the parallel translations in the five other languages appearing in horizontal columns for maximum utilization. Indexes in five languages are also included so that the user can locate a specific term rapidly and easily.

This dictionary deserves an honored place in any well stocked technical library.

* * *

"COLOR TELEVISION FUNDAMENTALS" by Milton S. Kiver. Published by *McGraw-Hill Book Company, Inc.*, New York. 309 pages. Price $6.00.

This is an expanded and revised edition of the author's series, "Fundamentals of Color TV," which originally appeared in the March through November 1954 issues of this magazine.

Now that color is becoming an accepted part of network programming schedules more and more color receivers are going to make their appearance. This slowly growing acceptance of colorcasting is of vital interest to technicians since they will be entrusted, for the most part, with the task of insuring good reception. Color sets will require more servicing, more troubleshooting, and more careful consumer instructions than black-and-white receivers of the same tube size. Technicians familiar with color circuitry and the fundamentals of color will be in an enviable position professionally—since they will be "specialists."

One excellent source for such "professional training" would be this work by Mr. Kiver. He has covered his subject matter progressively so that the student can tackle the more advanced concepts after acquiring the proper "background" for the circuitry under discussion.

The text material is lavishly illustrated with schematics, charts, graphs, and color plates. Two appendices covering additional facts on color TV and technical specifications of the NTSC color signal are supplemented by a glossary of color television terms. All-in-all this is a practical, complete, and worthwhile handbook for the practicing technician and the student.

* * *

"YOUR TAPE RECORDER" by Robert and Mary Marshall. Published by *Greenberg, Publisher*, New York. 273 pages. Price $4.95.

Subtitled "How to Select One and Get the Most Out of It," this volume is directed to the non-technical user of home recorders. Today tape equipment turns up in the hands of such diverse consumers as clergymen, Scout leaders, teachers, housewives, schoolchildren, college students, and club members. The authors of this volume acknowledge and recognize the fact that, for the most part, such users do not have the technical background or training of a recording engineer and that for them to get the maximum benefit and fun from their equipment they must have a non-technical handbook for guidance.

This book meets this need from sev-

eral standpoints. Not only is the theoretical background material covered in simple, easily-understood language but the actual operation of various types of equipment is described in detail.

A wide assortment of commercial tape machines is illustrated and described along with the salient features of their operation. A directory of recorder and accessory equipment manufacturers is appended for the benefit of the person who is still "looking around" for the recorder to meet his needs.

The imaginative applications for tape recorders form an interesting and instructive part of this text and those who think of such devices only as a means of preserving Junior's first Sunday-School recitation will be amazed at the wide variety of uses for such gear. In addition to the amount of information and instruction to be gleaned for this text, the book makes good reading for both the owner and non-owner alike.

* * *

"TV MANUFACTURERS' RECEIVER TROUBLE CURES" by Milton Snitzer. Published by *John F. Rider Publisher, Inc., New York*. 103 pages. Price $1.80. Paper bound. Vol. 7.

This is the seventh in the current series covering television troubleshooting procedures as outlined by the manufacturers of the sets.

This volume covers sets made by *General Electric, Hallicrafters, Hoffman, Jackson, Kaye-Halbert, Magnavox, Majestic, Mars, Mattison, Meck, Montgomery Ward, Motorola, Muntz, Pacific Mercury, Packard-Bell, Philco, Philharmonic, Radio Craftsmen,* and *Raytheon.*

A cumulative index of the previous issues has been included in this volume to facilitate easy location of the chassis being serviced.

* * *

"PICTURE BOOK OF TV TROUBLES" by the Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 84 pages. Price $1.80. Paper bound. Vol. 4 ("AGC Circuits").

This fourth volume in the current troubleshooting manual series is devoted exclusively to delayed a.g.c., triode keyed a.g.c., pentode keyed a.g.c., and amplified keyed a.g.c. circuits.

As with the previous volumes in this series, the laboratory staff of the publisher actually serviced a great number of television receivers exhibiting a.g.c. troubles and have presented the results in the form of CR patterns and scope test results. In this way, the technician can determine the probable cause of the trouble by comparing the picture tube display on the set he is servicing with the examples included in this text. The correct servicing procedure is then outlined for speedy correction of the shop fault.

Those who have used this system of troubleshooting can attest to its effectiveness and will welcome the appearance of this additional material on still another TV receiver circuit. —30—

New Record Players

(*Continued from page 43*)

muting switch short-circuits the cartridge during the change cycle.

Audiophile net for the "Dekamix" is $49.95 including the crystal pickup, turnover-type dual sapphire styli, and spare pickup shell.

German-Built "PE Rex AA" Changer

The U.S. distribution of the German-built "Rex AA" record changer is being handled by *Fenton Company*. Specially designed to accommodate American cartridges, this new changer will intermix any odd size records between 6" and 12".

The mechanism consists of a shock-mounted, four-coil capacitor motor. Even the narrow frequency band caused by the vibration of the motor drive is eliminated through the damping of double chassis, suspended on factory-tuned springs.

The change-cycle mechanism is of new design. At the end of a record it is automatically activated whether or not the record is provided with fast-finishing grooves. To assure silent operation during playing, the driving gear of the change cycle retracts after each cycle change. Thus only the drive mechanism engages the turntable during the playing cycle.

With its long, small vertical mass, non-resonant pickup arm, and friction-free horizontal bearing, the unit provides perfect tracking on any record irrespective of its irregularities. The arm weight is easily adjustable through a knurled knob on the side of the pick-up arm. As an added feature, each unit is supplied with a short manual spindle so that single records can be played. The unit will shut off automatically even when used as a player rather than a changer.

The "Rex AA" comes equipped with two empty plug-in shells or with one plug-in shell either with the PE-8 crystal or P-600 series magnetic cartridges. These cartridges are now supplied with standard American mounts. This changer is priced at $59.50.

The Presto "Pirouette"

Under the tradename "Pirouette," *Presto Recording Corporation* is now marketing a three-speed turntable which will handle 33⅓, 45, and 78 rpm discs.

The new unit replaces the company's Model 15 in the line. Like the T-15, it has a 12" diameter cast-aluminum turntable. As an added feature, however, the turntable carries a 45 rpm disc, permanently attached to the turntable spindle which retracts under the surface of the turntable when not in use.

The drive system utilizes three rubber idler wheels, one for each of the three turntable speeds. The idlers are interchangeable so that one spare may replace any one of the three operating idler wheels.

A single control lever, operating in a horizontal plane, selects the correct speeds or shuts off the mechanism. The control locks positively in each of the three speed positions and, in the "off" position, retracts the idler from the drive shaft to prevent flats from developing on the rubber surface.

This model is available with either a standard four-pole shaded induction motor at $53.50 or with a hysteresis synchronous motor at $108.00.

New Swiss-Made Units Introduced by Thorens

Thorens Company is currently introducing several new Swiss-made units which feature enhanced performance and new operating convenience.

The new units are powered by a direct-drive motor utilizing a separate gear for each standard speed. Operating convenience is enhanced by the adoption of a dial action control knob for selecting the three standard speeds. Concentric with this dial is a fine-tuning knob which permits "exact" pitch adjustments within a 5% latitude above and below each of the standard speeds, during audition. This feature is of special interest to the serious musician blessed with perfect pitch.

The CD-43 record changer and the CBA-93 "Audiomatic" record player both have provision for manual operation. A flick of a switch disengages the automatic trip mechanism, allowing greater flexibility. The CD-43 is $93.75 audiophile net while the CBA-93 is priced at $67.50 for audiophiles.

The company's professional-type turntable has been designated as the E-53PA and includes the same operational innovations as the changer and player. The turntable is offered at $60.00 audiophile net without the tone arm or cartridge.

V-M Corporation Changers

One of the newest record changer mechanisms in the *V-M Corporation* line is the Model 1200 which will handle three speeds (33, 45, and 78 rpm) automatically and operate at the new 16 rpm "talking book" speed manually.

The changer has a new patented-drive, four-speed motor which insures constant speed at all times. The low-torque mechanism offers minimum wow and silent, rumble-free performance. A new three-spring mounting provides absolute stability and balance.

The die-cast aluminum tone arm is balanced for minimum needle pressures as specified by the needle or cartridge manufacturers. The underside of the tone arm is calibrated to allow exact adjustment. A new anti-skate mechanism positively controls the motion of the tone arm after landing, preventing skating even under severely tilted conditions. This same mechanism also allows a point-thrust bearing on the tone arm to reduce side wear on record grooves thus enabling lighter needle pressures for proper tracking to substantially reduce record wear.

Another convenience feature of this

model is the "Easy-Lift" record support arm for front loading facility. The Model 1200 is available with a *G-E* variable reluctance cartridge as well as with dual-needle ceramic cartridges. Both versions can be purchased with a matching pan for open shelf or table-top use. The Model 1200 is $46.50 list.

A second model in *V-M's* line is the Model 1250. Like the Model 1200, it will handle four speeds, the 33, 45, and 78 rpm discs automatically and the 16 rpm discs manually. The mechanism specifications are the same as for the Model 1200 but, in addition, the Model 1250 includes a convenience outlet on the back of the unit.

In addition, the changer incorporates a "Siesta Switch" which turns the entire mechanism off; including the amplifier, after the last record has been played. An auxiliary output, with 8 ohms impedance, is provided for use with external speakers. This unit is $59.95 list.

Three other units are also available in the firm's current line: the Model 1275 4-speed unit, housed in a portable case, which retails at $79.95; the Model 1285, another 4-speed unit in a table cabinet which can be converted into a consolette with the addition of optional legs, at $99.95; and the low-priced Model 155 portable at $49.95 which also offers 4-speed operation and several other features.

While we have attempted to present the most outstanding features and the operational highlights of these new units, readers desiring additional information on any of the players or changers mentioned may obtain this data by writing to Dept. 1010, RADIO & TELEVISION NEWS, 366 Madison Avenue, New York 17, New York. —30—

SYRACUSE "V.H.F. ROUNDUP"

THE Syracuse V.H.F. Club of Syracuse, New York is planning a "V.H.F. Roundup" for Saturday, October 15th. The affair is scheduled to start at 2:00 p.m. at Frank Taylor's on U.S. Route 11 in North Syracuse. The featured speaker is to be Art Koch of General Electric whose numerous articles on low-noise converters appear in "G-E Ham News."

Tickets are $2.50 per person and are available from Joe Lando, K2UIM, RD #1, East Syracuse, New York. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE rapid strides that have been made by the independent electronic service industry toward maturity in business thinking is best reflected in the excellent association house organs that have been created during the past few years.

The editorial content of these well-conceived publications reveals a wealth of good writing talent among the operators of full-time service businesses and incisive judgment on the basic problems of the service industry. It is extremely interesting to observe the growing attention that is being given to knowing the actual costs-of-doing-business as a basis for sound labor pricing of service work.

"TV Flashes"

Last fall, a rather unpretentious house organ appeared that carried the name *TV Flashes*. It was introduced as the monthly voice of the Television-Radio Association of Alameda County, Inc., of Oakland, California. In the course of a few months, *TV Flashes* graduated from mimeograph to letter press. Well supported by San Francisco Bay distributor advertising, the editorial content has grown steadily.

Edited by Ernest S. Copley who operates the *Foothill TV Service Company* in Oakland, the TRA house organ has followed a realistic path editorially in its coverage of basic service problems in California.

California service associations, jarred by a badly handled newspaper exposé of television service "gyppery" in the San Francisco Bay area that left every independent service shop under a cloud of consumer suspicion, started the ball rolling to develop a coordinated statewide program in the interest of established, ethically-operated service shops and servicing dealers. Eleven service associations, representing about 350 member shops, met in San Francisco to formulate plans to interest operators of legitimate service shops throughout the state in a cooperative program to identify the ethically-operated service shops for the public.

The "San Joaquin Plan," tentatively adopted as the basis of a constitution for a state-wide cooperative organization, provides for coordination of local group activities, an educational program aimed at the public and the trade itself, the presentation of a stronger service front in intra-industry dealings, and the development of an adequate state licensing law to put the illegitimate operator out of business.

"TSA News"

The Television Service Association of Michigan, Inc. has chalked up a record of achievements probably without parallel among service associations operating in metropolitan areas. Before TSA was officially launched, leading Detroit service operators studied the organizational and operational patterns of all of the TV service associations that were functioning at that time. Organized as an association of service businesses, TSA has spearheaded, and usually initiated, every program and campaign to create a healthy business atmosphere for electronic service in the Greater Detroit area.

The voice of the association is the *TSA News*, a well-written, professionally prepared monthly house organ edited by Harold E. Chase, president of *Chase Television Service* and former president of TSA. A recent issue of *TSA News* clearly reflects the wholehearted spirit of cooperation that permeates the entire TSA organization and, in a measure, has been responsible for the association's unusual record of achievements.

Their interest in dealer problems resulted in their affiliation with NARDA. Touching on the industry problems that are of common concern both to dealers and service operators, the *News* reported the following points of mutual interest from a talk given to the association by A. W. Bernsohn, managing director of the national dealer association:

1. Vigorous opposition to central service by manufacturers.
2. Joint promotional and merchandising efforts to build business to higher levels during peak periods and to find fill-in activity during slack periods.
3. Mastery of sounder business management techniques.
4. Better understanding of operational costs.
5. Close cooperation with Better Business Bureaus and District Attor-

neys for decisive action against those who would take advantage of consumer confidence in the industry.

6. Establish codes of ethics, standardized advertising programs, and other yardsticks for honorable business operation.

7. Standardization of warranties, interpretation of warranties, and greater simplification of tube and parts replacement methods.

TSA has long been noted for its deep interest in cooperating with other service associations. In most areas, when competitive service associations are formed, there is a marked tendency for the groups to either fight or "not recognize" each other to the detriment of association influence in the area. TSA has openly welcomed other associations both in the Detroit and outstate areas to join with them in any program for the betterment of service as a whole. Presidents of the Electronic Service Association, the Television Technicians Association, and the Michigan Electronic Association recently met with TSA members to formulate plans to drive for a Michigan State service licensing bill along the lines of the TSA measure proposed for the city and now under consideration by the Detroit City Council.

Significant of the outstanding role the association plays in the electronics industry in its area was the selection of TSA by the Detroit Educational Television Foundation to spearhead the campaign to promote Detroit's educational station WTVS, which will broadcast over channel 56. Under the capable direction of Alexander Weiss, TSA's dynamic president, the association will be the key figure in making the auto capitol's venture into educational TV an outstanding success.

The *TSA News* correlates the information on the association's numerous programs to keep the membership fully aware of all phases of their group's activities.

The "Guild News"

The management of an electronic service business in a metropolitan area is a soul-singeing experience for those whose business morals deter them from stooping to unethical practices. Set owner gullibility seems to increase in ratio to the population. Advertising of ethical shops in community and other newspapers is constantly overshadowed by blaring ads that offer service free and tubes and parts at wholesale.

However, in practically all metropolitan areas, there are determined men who run ethical, independent service shops who are willing to give unstintingly of their time and effort to drive the gyps out of the electronic service business. The Radio Television Guild of Long Island is an organization of men of this caliber. Their voice is the *Guild News*, a monthly house organ that pulls no punches in its coverage of industry developments that affect service. Edited by Ralph Milne with an able assist from the Guild's hard-working president, Murray Barlowe,

the *Guild News* has become an important element in distributor and service circles on Long Island.

While its technical lecture programs, with meetings held successively in the three boroughs covered by Guild membership—Nassau, Suffolk, and Queens—are of top caliber, the Guild has captured national industry attention because of its regular monthly "Distributor Shopping Program."

In its efforts to discourage the indiscriminate sale of replacement products at dealer prices, the Guild started a plan to shop every distributor that served the area once a month to determine which distributors were confining their sales of replacement products to identifiable service accounts. The results of each month's shopping experiences are shown prominently in the *Guild News*. Advertising for the *Guild News* is not accepted from distributors who fail to measure up to expectations in the monthly shopping reports.

"ARTSD News"

The Associated Radio-Television Service Dealers of Columbus, Ohio, is the industry's oldest service business association. Organized almost fifteen years ago, ARTSD developed a pattern of meetings that it has carried out with signal success ever since.

ARTSD is an organization of service businesses and its constitution stipulates expressly that an association business meeting must be held every month. Top-flight technical meetings are scheduled every three months and these are open to all service technicians in the area whether or not they are employed in a member business. Quarterly meetings with parts and set distributors, in which top level distributor executives are dinner guests of the association, have done much to keep out both gyp jobbers and gyp service operators.

The tie-point in the association's activities is a newsy, mimeographed monthly house organ called *ARTSD News*. Edited by John Graham, senior partner in the firm of *Graham & Colton*, *ARTSD News* carries a running account of the members' activities, both social and business. As you follow the activities of ARTSD members in their monthly *News* you realize that service businesses are run by people—the kind of people who are the real backbone of our country's strength.

Other Publications

Most of the wisdom acquired by man down through the ages has been wrapped up in little capsules called axioms or adages. Those who read with an open mind and imagination find a wealth of meaning in these terse, simple sentences. Members of the Kansas Appliance Dealers Association and the Wichita Appliance Dealers Association are exposed to a very meaningful one when they read the weekly copies of their association house organ, *The Yardstick*.

"It is better to light one candle than to curse the darkness."

They lit one candle when they formed the Wichita Appliance Dealers Association and it glowed so brightly in accomplishments that its light spread across the state and resulted in the formation of the Kansas Appliance Dealers Association.

The Yardstick is edited by C. D. "Jack" Hughes, manager of KADA and WADA and its service section is edited by Jack Dole. Each week the editors select the most pertinent articles that appear in the monthly dealer and service trade magazines and reproduce them in *The Yardstick* to help their busy members keep abreast of the current thinking on all phases of retail and service business management.

The Syracuse Television Technicians Association has embarked on an aggressive program to build its influence in upstate New York. Their monthly house organ, the *STTA News* is edited by their board of directors.

STTA is affiliated with the Empire State Federation of Electronic & Television Associations and the National Alliance of Television & Electronic Service Associations. Writing in the June-July issue of the *News*, member Bud Bennett had this to say about "Our Association":

"A few years ago, technicians did not have the opportunities or honor of being associated with the finest group of men as I have today in our association, the STTA.

"I can remember working into the wee hours of the morning on a 'dog' television set and spending many valuable hours that could be used to improve my business more quickly. Now just a phone call to an association member eliminates many so-called 'dog' sets.

"I recall that at the last business meeting one of the members stated that he felt that just listening to other technicians talk and discuss technical and business practice has taught him much and has improved his business greatly.

"Talking to non-member technicians, this writer has heard stories about STTA controlling the member's business, telling them what they are going to do, what they are going to pay for their help, what they are going to charge, etc. These statements are all false. On the contrary, business of the members has increased by leaps and bounds, and this condition has occurred because the members have gained valuable knowledge and security (our group insurance plan) as members of STTA."

A spritely newcomer in the field of association house organs is the the 16-page, slick paper *MTTTA News* published by the Middle Tennessee Television Technicians Association of Nashville. Edited by the association president, Cordell Britt, the second edition carries a balanced variety of technical and general news.

The association's board of directors recently appointed an investigating

committee to promote better customer—shop owner relations. Letters from customers complaining about service or charges will be handled by this committee. After contacting both the complainant and the shop to get a complete history of the transaction, the committee will give the board of directors a complete report for action.

Another newcomer is the *ATSCO News*, the official monthly publication of the Association of Television Service Companies of Cincinnati, Ohio. Harold J. Gruber is its editor and advertising manager.

In the second issue, Richard E. Mueller, president of the association reported to the membership:

"At our June meeting the committee on licensing presented proposals on licensing which were overwhelmingly approved by all in attendance. The committee will put the finishing touches on it and have it ready for final approval at the July 12th meeting.

"It was unanimously agreed at the June meeting that members extend a courtesy discount of 40% on tubes to other members caught short in the field. This is another example of the splendid cooperation that participation in the organization brings forth.

"Perhaps you heard about the boat trip and hot-dog roast we had last year. Every one enjoyed it thoroughly, so much so that we hope for *two* of them this year. The first one should be within a month—special notice will be sent out. I'd like to point out that these social affairs contribute much to bringing us closer together and in the exchange of ideas. To you fellows 'on the fence' who like what we are accomplishing but are letting others carry the ball, *stop—think—act*. We can accomplish more with your active support."

A robust stripling was recently introduced into the field of association house organs when *LIETA News* made its 12-page, slick paper bow. P. W. Botsch, Jr., is editor of this striking new magazine published under the banner of the Long Island Electronic Technicians Association.

William A. "Dick" Carey, president of LIETA, presented an unusual, new idea to members in the May-June issue:

"A credit plan is needed for the technician on service to compete with the department stores who are selling service on such a plan. I have checked several finance companies to see if such a plan could be arranged to make the technician's financial life a little easier. Some companies turned down the idea because they do not handle 'service receivable,' that is, bills for work done rather than goods sold. Some finance companies do seem interested in the plan.

"1. Loans could be made directly to the individual service shops on the basis of shop equipment as collateral and accounts receivable as an indication of forthcoming income. The technician could extend credit to his

customers on big jobs but would be responsible for collecting the payments himself. This could prove troublesome.

"2. Lenders are much more eager to deal with the single large sums which would be involved here. (*Editor's note:* the large bills would be a combination of the small bills of members.) The local clearing house could be sponsored by our association. Each technician would lump say $200 of jobs under one loan, with ten or more this would involve $2000 or more and the central agency could afford to relieve the individual technician of the burden of bill collecting." —30—

PHONE-TIP TO PHONE-TIP ADAPTERS

By ARTHUR TRAUFFER

WITH these easily made couplers you can quickly add extension cords to earphones and speakers, or quickly connect together any wires which have phone-tips on the ends.

As shown in Fig. 1 (bottom), simply push the split lug of one tip-jack into the split lug of another tip-jack, and then join them together with a drop of solder. This makes a single coupler which will join together any two cords with phone-tips on the ends.

You can make the coupler more rugged and improve its appearance by removing the two hex nuts and wrapping a few turns of wide tape around the threaded shanks of the jack as shown in Fig. 1 (top). The writer used "Mystik Tape" cut to a width of about 1⅜".

You can make a double coupler by simply taping two single couplers side-by-side. See Fig. 2. This makes a handy coupler for adding an extension cord to a pair of earphones which are connected to a TV set, etc. When making this double coupler, be sure that the two single couplers are taped individually before taping the two single couplers side-by-side, otherwise one coupler will short against the other. —30—

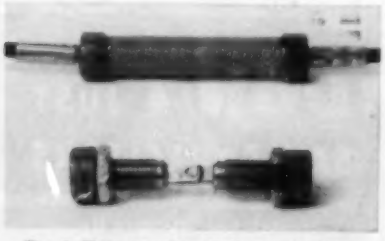
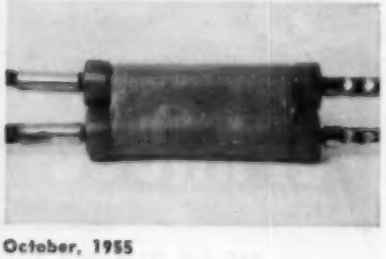


Fig. 1. How to make single coupler from two tip jacks and how to dress it up.

Fig. 2. A double coupler can be made of two units, each one individually taped.



Mac's Service Shop

(Continued from page 74)

insure he was connecting his instrument to the proper point."

"How about the new transistor equipment?"

"Well, I certainly am not in favor of soldering these little gadgets into the circuit. If at all possible, the transistors should fit into sockets. When this is done, a doubtful transistor can be quickly checked by the old reliable try-a-good-one technique. I fully expect to see tube checkers equipped with sockets for testing transistors in the very near future, but this will not do much good if the transistors are equipped with solder leads instead of socket pins. The transistor people should remember the case of the selenium rectifier. When these were first introduced, they were supposed to have almost an unlimited life, too; but you'll have a hard time selling this story to a present-day technician who replaces a couple of dozen of them a week. In the past few months the selenium rectifier manufacturers have started to remove the growing prejudice against these hard-to-replace units by making them plug-in; but if this had been done in the first place, the prejudice would never have arisen."

"I'll certainly go along with that," Barney agreed; "and if the selenium rectifiers had been made plug-in right from the beginning, this would have kept set designers from burying them in hot spots underneath the chassis where lack of ventilation shortens their life. But what would you do if you were designing such equipment?"

"There's a problem that's very real," Mac remarked. "Both of us already have noticed that the printed circuit sets beginning to pass through the shop show a wide difference in ease of servicing. In being critical, of course, we must remember that one of the chief advantages of the printed circuit lies in the simplification of manufacturing. We can hardly expect a manufacturer to discard a large part of this important advantage just to make printed circuit sets easier to service. I'm convinced, however, that these sets can be made easier to service without making them difficult or costly to assemble.

"For instance, take the case of a filter capacitor with four or five leads. If these leads come right out the end of the can and pass through separate holes in the printed circuit board and pull the edge of the can tight against that board while they are soldered into place, removing that capacitor is a real chore. All five solder connections must be heated at the same time. While I realize that miniature solder pots are coming on the market to do this job, I feel that making it necessary for the technician to buy highly-specialized new equipment to work on these new sets is not going to increase his affection for them."

"I'm sorry to hear you say that," Barney offered. "I've just been working on my new Hydra Solder Gun. You see it has a half dozen separate flexible tips all connected in parallel. You just bend these around so each one is in contact with a joint you wish to break and pull the trigger. All tips get hot at once—and there you are!"

"I'd like to see you watching all six of those contacts at once," Mac said with a chuckle. "Anyway, that isn't necessary. The other day I had a printed circuit set that needed a new filter capacitor, and replacing it was a breeze. Instead of the leads coming out the end of the filter can, they came out at regular intervals around the side, about a half-inch from the end, and then went straight down through holes in the circuit board. All I had to do was clip these leads off right close to the can and solder them to the leads of the replacement capacitor. The soldering iron never touched the printed circuit board at all. What's more, that type of capacitor was just as easy to install in the factory as was the other type I mentioned; yet look how much easier it was to replace. The kind of thinking behind it should be applied to all printed circuit sets. If this is done, the technician will welcome these new sets and will provide invaluable aid in 'selling' them to the customers; but if his interest and convenience is ignored—well, if the manufacturer could know how often the technician is asked, 'What kind of a radio or TV set should I buy?' that policy would be quickly reframed."

"Yep," Barney agreed; "you might say that all we technicians want is just a little ride on the wheels of progress instead of feeling they are rolling over us." —30—

PHOTO CREDITS

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37	Radio Corporation of America
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57	Admiral Corporation
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63 (right)	TeleTest Instrument Corp.
91	Trio Manufacturing Company
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114	United Air Lines
142	Diamond Ordnance Fuze Laboratories
166	Westinghouse Electric Corporation

ERRATUM

C, in the parts list accompanying the article "An Amateur U.H.F. Receiver" (August, page 47) should be a Johnson 9MB11 butterfly type instead of the 9M11 specified.

ANSWERS TO "HI-FI QUIZ"

(See page 116)

1. b	6. a
2. b	7. c
3. c	8. b
4. a	9. a
5. c	10. a

INDEX OF Advertisers

OCTOBER 1955

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

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COMPLETE Tape-Disc Recording System—16" custom Presto disc recorder—model 900 Presto tape recorder—16" turntable—microphones—all accessories. This equipment in A-1 condition. Everything necessary to record professionally on tape or disc. Rock-bottom price $2200.00 complete F.O.B. our floor. Worth at least double. Write or call Warren R. Smith, Inc., 117 Fourth Ave., Pittsburgh 22, Pa. EXpress 1-4410.

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RADIO equipment, Navy surplus just released, good condition, used, complete with tubes. Transmitters—BC 696A, 3 to 4 MC $8.00 ea. BC 457, 4 to 5.3 Mc $4.50 ea. BC 458, 5.3 to 7 MC $4.50 ea. Receivers—BC 453, 190 to 550 KC $8.00 ea. BC 454, 3 to 6 MC $4.95 ea. BC 942A 100 to 156 MC $8.00 ea. Transmitter New BC 458 $7.00 ea. Order C.O.D., F.O.B. Birmingham. Inquire if interested in large quantities. Rogers Trading Company, 2325 Second Ave. North, Birmingham 3, Ala.

BC-348P RECEIVER, brand new, original carton, covers 6 bands, 200-500 kc., 1.5-18 mc. Designed for 28 v.d.c., easily converted to 117 v.a.c., $75.00 f.o.b., New York. Box 51, % RADIO & TELEVISION NEWS.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TELEVISION Receivers, $28.80 Up. W4API, 1420 South Randolph, Arlington 4, Virginia.

TRADE-IN Television Sets $14. Jones Radio, 1115 Rambler, Pottstown, Pa.

HEARING Aids, as is $7.50. In operating condition $12.50. Shelby Instrument, 1701 Magnolia, Long Beach, Calif.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. 853, 36 Columbus Ave., New York 23, N. Y.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 512 Broadway, New York 12, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

COMPLETE VHF Radio Terminals. These are designed for telephone service in the 72-76 mc. band, and are ideal for setting up a communication system along a pipeline, railroad, or in mountainous or bush country. Each terminal consists of the following: 1—Link Radio Type 149ST Transmitter; 1—Link Radio Type 149SP Power Supply; 1—Link Radio Type 149SR Receiver; 1—Budelman 200 watt Power Amplifier; 1—Type PP13 Power Supply; 1—Federal Type 101B V-F Ringer; 500 ft. —Type RG 8U Coaxial Cable; 2—Welded steel Yagi Antennas—5 element; 1—Lister Diesel-Generator set, 2KW. F. J. Plishner, 550 Fifth Avenue, New York City.

TV Trade-In sets. Philco, R.C.A., Emerson, others. List available. 10"—$17. 12" to 17"—$20. up. Washtek Service Co., Dept. R, 956 Southern Blvd., Bronx, N. Y.

FOR Sale—Geiger Counter Kits $38.50. Geiger Counter & Scintillator Diagrams $1.00. Free Catalog. "R. F. Chambers," 13833 San Antonio Dr., Norwalk, Calif.

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RADIOS, New, $13.46 net and up. Details 10c. Sonoret, Box B, 36 Woodbury St., Wilkes-Barre, Penna.

S-BASE Transmitters with Towers, Antennae, etc., several Mobile transmitters, all Motorola, excellent condition, Used, two years. Box 3091, West Palm Beach, Florida.

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TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

TAPE Recorders, Accessories. Best values. Trade-ins accepted. Will quote on hi-fi components. Boynton Studio, 10R Pennsylvania, Tuckahoe, N. Y.

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WILL Buy All. ART-13/type T-47A $225.00. ART-13/type T-47 $150.00. BC-788C Altimeters Receiver, $150.00. R5/ARN7 Radio Compass $160.00. ARC-3 Complete $185.00. BC-348 Rec'r Modified $35. BC-348 Rec'r unmodified $50. ARC-1 Radio $150.00. BC-312 Rec'r $40.00. BC-342 Rec'r $50.00. Ship Via Express C.O.D. Subject to inspection to: H. Finnegan, 49-57 Washington Ave., Little Ferry, New Jersey.

WANTED—Electronic Tubes, all types. Also want all types airborne electronic equipment: ART-13; BC-788; I-152; ARC-1; ARN/7, etc. Top dollar paid! Bob Sanett, W6REX, 1524 S. Edris Dr., Los Angeles 35, California.

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